ENERGY MANAGEMENT SYSTEM (EMS) STUDY

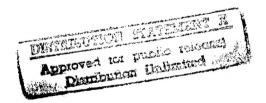
Fort Belvoir, Virginia

Department of the Army Baltimore District U. S. Army Corps of Engineers

COE Project No: DACA31-92-D-0061

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DEPARTMENT OF THE ARMY

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Energy Management System (EMS) STUDY

Fort Belvoir, Virginia

Prepared by:

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I. EXECUTIVE SUMMARY

A. INTRODUCTION

General Location: Fort Belvoir is an 8,656 acre Post held fee simple by the US Army. It is located in the Commonwealth of Virginia, 14 miles south of Washington, D.C., situated primarily on a peninsula of the Potomac River. Interstate 95 and US Route 1 provide primary transportation links to Norfolk, Washington, DC, and other cities. Fort Belvoir is an Army Installation under the Command of the United States Military District of Washington (MDW).

Installation Mission: Since 1988 and its transfer to the MDW, Fort Belvoir's mission has shifted from training to service to MDW and the National Capitol Region (NCR). Within its eight mission elements are: contingency military support to the NCR, Regional Administrative Center, Regional Logistics Support, Regional Recreation Center, Classroom Center, Housing and other regional activities. The Installation is now referred to as "U.S. Army Fort Belvoir".

Ft. Belvoir has been tasked, by Executive Order 12902, with reducing the total energy consumption on the Installation by 30% of the FY1985 level by the year FY2005. The purpose of this study is to determine the most effective Energy Management Systems (EMS) to install to assist in meeting this challenge. The analysis performed was based upon five buildings of different function, occupancy and scheduling, as well as different types of mechanical systems. Three different EMS types were analyzed for their advantages and applicability to each building. The results of this study are to be used to evaluate other buildings on the Installation. The three types of systems analyzed for this study are the FM Relay (FMR), the Power Line Carrier (PLC) and the Direct Digital Control (DDC) Systems.

B. PURPOSE

The purpose of this study is to compare three different types of energy management systems and determine which system would be most effective in each of a variety of different buildings. The three systems chosen for this analysis are the FM Relay (FMR), Power Line Carrier (PLC) and Direct Digital Control (DDC) systems. The analysis performed was based upon five buildings of different function, occupancy, and scheduling as well as different types of mechanical systems. The recommendations listed in this report are to be applied over the entire Installation using the criteria listed for evaluating each building. This study will develop the recommended strategies for applying energy management systems (EMS) to many of the buildings at Ft. Belvoir.

C. BUILDING INFORMATION

The following is a list of the buildings which were analyzed for this study:

Building 200 - 26,256 square foot recreation facility

Building 219 - 32,937 square foot finance office building w/ auditorium

Building 247 - 148,067 square foot classroom building

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Building 1425 - 15,430 square foot administrative office building

Building 3136 - 11,760 square foot office building

Building energy simulations were performed for each building to determine the cost effectiveness of EMS application to each building. This information along with initial investment, maintenance and replacement costs were used to perform life cycle cost analysis for each system type being recommended.

D. PRESENT ENERGY CONSUMPTION

The estimated present energy consumption for each building is shown in Table 1 on page I-3. This table reflects the results of the energy simulation calculations for each building as it existed at the time this study was conducted. This is true for all buildings except building 1425. This building is presently equipped with a control system which utilizes a time clock to provide time of day scheduling. In an effort to provide a comparative analysis for other buildings which are similar in size and system type, but do not have time of day scheduling, it was decided that this building will be analyzed as if it were not equipped with a time clock. For this reason the results of the analysis for building 1425 are not applicable to this building but may be used as an example when evaluating other similar buildings.

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Table 1. Estimated Present Annual Energy Consumption

Table 1. Estimated Flesent	I Timudi Energ	y Consumpu			
	Building 200	Building 219	Building 247	Building 1425	Building 3136
Electrical Energy (kWH)	727,922	903,608	2,045,422	265,769	346,101
Electrical Energy (kBTU)	2,484,398	3,083,111	6,981,025	907,070	1,181,243
Electrical Cost (\$)	14,558	18,072	40,908	5,315	6,922
Natural Gas (Therm)	29,904	25,043	40,071		
Natural Gas (kBTU)	2,990,400	2,504,300	4,007,100		
Natural Gas Cost (\$)	18,182	15,226	24,363		
District Steam (kLBS)				254	434
District Steam (kBTU)				340,360	581,560
District Steam Cost (\$)				2,034	3,472
Total Annual Energy (kBTU)	5,474,798	5,587,411	10,988,125	1,247,564	1,762,334

E. ENERGY CONSERVATION ANALYSIS

ECOs Investigated

The following is a list of the ECOs investigated for this study:

Building 200

- FMR EMS
- PLC EMS
- DDC EMS

Building 219

- FMR EMS
- PLC EMS
- DDC EMS

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Building 247

- FMR EMS
- PLC EMS
- DDC EMS

Building 1425

- FMR EMS
- PLC EMS
- DDC EMS

Building 3136

- FMR EMS
- PLC EMS
- DDC EMS

ECOs Recommended

The following is a list of the ECOs recommended as a result of this study:

Building 200

DDC

Building 219

DDC

Building 247

DDC

Building 1425

FMR, PLC

Building 3136

FMR

ECOs Rejected

The following is a list of ECOs which were rejected as a result of this study

Building 200

- FMR
- PLC

Building 219

- FMR
- PLC

Building 247

- FMR
- PLC

Building 1425

^{*}The recommendations made for building 1425 are for comparison of similar buildings which are not equipped with an EMS. They do not apply to building 1425.

- DDC

Building 3136

- PLC
- DDC

The above listed ECO recommendations and rejections are based on the following criteria:

Building 200, 219, and 247:

Although the FMR system results in the highest SIR and the shortest payback period, this system does not provide comprehensive EMS capability and will not save energy. As shown in the capabilities summary the FMR is capable of demand limiting only. This eliminates the FMR from consideration as a solution to the problem of reducing the total energy consumption for the entire Ft Belvoir Installation. This system should be considered, however, for use with any building which has comfort cooling using electric chillers or condensing units and is not equipped with an EMS which is capable of demand limiting. Because of the short payback period and ease of installation, the FMR can be applied in a temporary fashion to buildings which may be scheduled for EMS installation beyond 2 years in the future. FMR systems installed for this purpose can be removed, after the new EMS is installed, and then re-used for another building on the Installation. When installing the FMR system care must be taken to ensure that the relays are used to initiate a normal equipment shut-down and not to simple disconnect the incoming power to the equipment. Until the entire Installation is outfitted with an EMS that is capable of demand limiting, the FMR should be applied as described above to generate cost savings at a very attractive SIR.

The PLC provides an substantial energy savings and SIR for each individual building as shown in Table 1 on page I-3, Table 2 on page I-11 and Table 3 on page I-12. The system, as evaluated in this study, is capable of providing time of day scheduling which accounts for the majority of energy savings attributable to this type of EMS. The PLC performs this time of day scheduling at the lower cost and a higher SIR than the DDC system.

The DDC system provides the greatest energy savings potential of the three systems evaluated, as shown in Tables 1 through 3. This is important as Ft. Belvoir continues toward the goal of reducing the total energy consumption by 30% of the FY1985 levels by the year FY2005. In addition to the increased energy savings potential the DDC system offers several features which are not available on the typical PLC system. These features, which are important ingredients for a comprehensive EMS in a multiple building Installation such as, Ft. Belvoir are as follows:

On-Line monitoring and control of the building systems from a central location. The DDC system provides this capability through a network arrangement which can utilize the existing fiber optics at Ft. Belvoir or dedicated phone lines between the various buildings. The typical PLC is capable of only intermittent communications via a modem in a central computer and the controller in each building.

- Demand limiting based on an Installation-wide strategy which monitors the electric demand at the main electric sub-station providing power to all of Ft. Belvoir. The PLC is capable of demand limiting or load shedding within each individual building only. It is not capable of controlling the demand strategy for all of the buildings on the Installation. The DDC system can be equipped to continuously monitor the electric demand from a meter at the sub-station and implement the appropriate demand limiting strategy for every building connected to a central control computer. This integrated approach is necessary at Ft. Belvoir because the demand charges assessed by the electric company are based on the maximum electric demand for the entire Installation not for the individual buildings.
- Increased control system reliability and maintainability. The DDC system installation will require the replacement of many of the existing pneumatic sensors, controllers and actuators each system. For this reason the control system reliability will be significantly increased in two ways. First the new components will be replacing components which are, in many cases over twenty years old and second the sensors and controllers used in the modern DDC systems are superior in many ways to the older pneumatic components. The DDC systems also require less maintenance since all of the logic functions are performed by solid state controllers with no moving parts as compared to the old pneumatic receiver controllers and logic controllers which require periodic calibration. The economic impact attributable to this increased reliability is impossible to accurately estimate but is generally thought to be significant in most cases. The PLC system utilizes all of the existing control components and will not increase the reliability or maintainability of the control systems.

Building 1425:

The FMR EMS should be installed on the chiller serving this building, because of the short payback period and ease of installation, the FMR can be applied When installing the FMR system care must be taken to ensure that the relays are used to initiate a normal equipment shut-down and not to simple disconnect the incoming power to the equipment. The existing control system in this building is currently equipped with the capability to provide the time-of-day scheduling which has been shown in this study to provide the largest single economic advantage of an EMS. Therefore, it is not advisable to install an EMS with time-of-day scheduling capabilities.

When analyzing similar size buildings served primarily by perimeter fan-coil units and central air cooled chilled water, and district steam heated hot water systems the PLC should be considered as an option for maximum energy savings while meeting ECIP funding criteria.

For new buildings or buildings where major mechanical renovation is planned the DDC system will should be considered for applications similar to this building. Because the DDC system would provide all of the control system and EMS capabilities the required investment in the EMS portion would be considerably less than "adding" EMS capabilities to existing systems.

Building 3136:

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The age and condition of the fan coil units and the control system in this building make it a candidate for a mechanical system replacement. An example is that the fan coil units are not equipped with control valves to stop the flow of water through coil when cooling or heating is not needed. This situation causes the fan coil units to act as radiators during the heating season even after the thermostat has been satisfied and has cycled the fan off. The installation of total system EMS at the time of new equipment installation would be more cost effective.

The building is served by a packaged air cooled chiller which can be cycled to provide electrical demand savings. This building should be equipped with and FMR relay and entered into a demand limiting schedule in accordance with the strategy outlined in Example 2.1 on page II-2 of this report.

ECIP Projects Developed

The following is a list of ECIP Projects developed as a result of this study:

Building 200 - DDC EMS	SIR 1.93
Building 219 - DDC EMS	SIR 2.03
Building 247 - DDC EMS	SIR 1.91
Building 1425 -FMR EMS - PLC EMS*	SIR 7.17 SIR 1.55
Building 3136 - FMR EMS	SIR 7.17

^{*}The PLC recommendation made for building 1425 are for comparison of similar buildings which are not equipped with an EMS. This does not apply to building 1425.

The supporting data for these projects is shown in tabular form in Section F of this summary along with the Life Cycle Cost Analysis Sheets for the ECIP Projects.

F. EXTRAPOLATION OF RESULTS

Based on the results of this study the DDC EMS provides the greatest benefit of all the system evaluated for this study. The benefits of the DDC system can best be utilized by installing the systems with an emphasis on Installation-wide control and monitoring. This can be accomplished most effectively by packaging all of the buildings on the post which meet the criteria for EMS installation and acquiring competitive bids from qualified manufacturers and installers with experience in large multiple building Installations. It is also important to specify the requirement that all of the buildings be linked to a central control computer via a network arrangement utilizing the existing fiber optic facilities where possible and dedicated phone lines elsewhere. Another major consideration in evaluation of the manufacturers and installers is the availability and reliability of the support personnel who will be responsible for maintaining the system. It is also important that the manufacturers provide sufficient training

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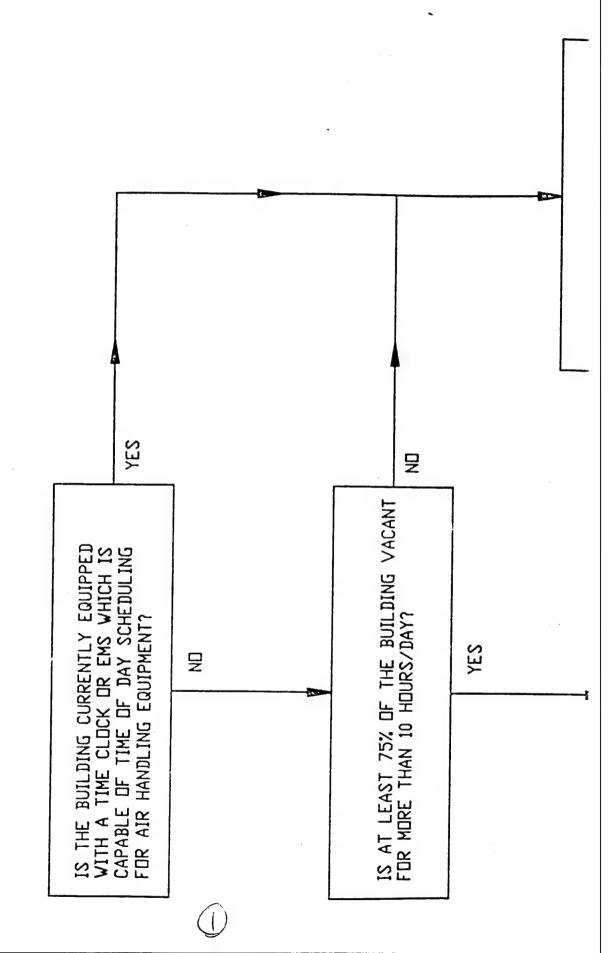
for Installation or contract personnel who are responsible for maintaining the mechanical equipment.

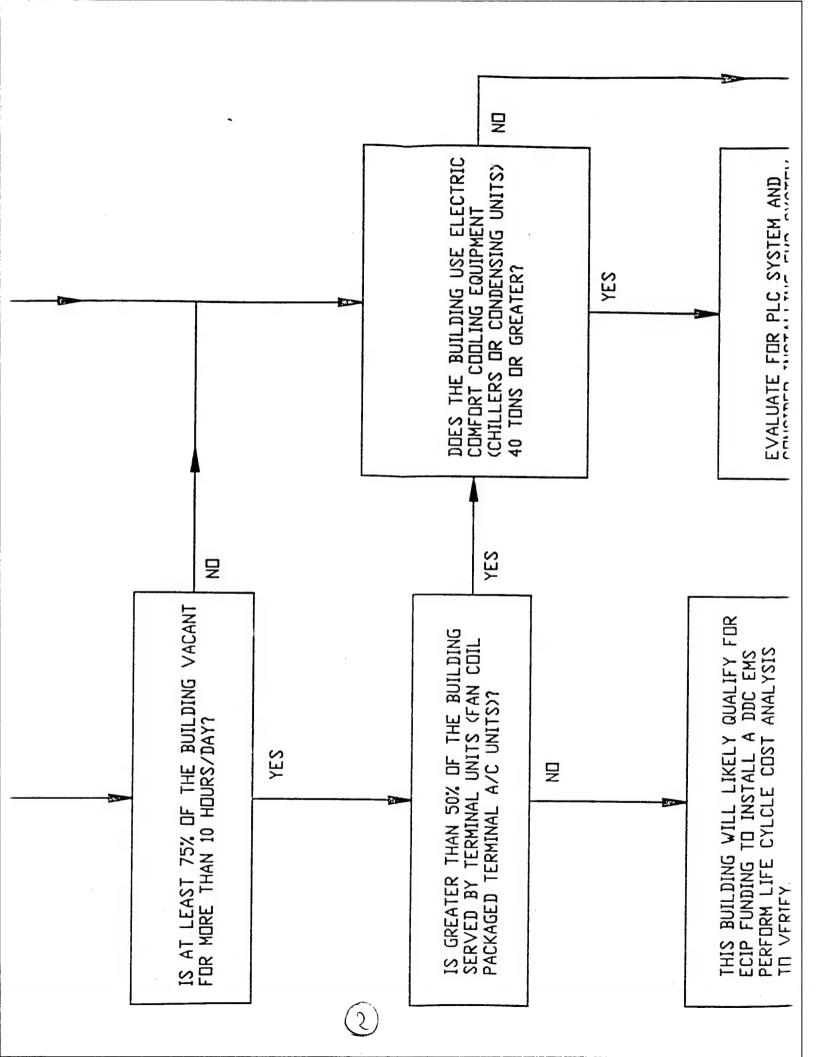
If it is not possible to perform a full scale Installation-wide implementation of the DDC systems as described above, an alternate approach can be taken. The alternate approach would be to divide the Installation into groups of buildings and acquire competitive bids for each individual group as funding becomes available. The disadvantage to utilizing this alternative approach is that the different manufacturers will likely be used for each group of buildings. This would require the installation of a central control computer for each different manufacturer or an integration package would be required to consolidate the systems into one central control computer. There are manufacturers who are currently providing integration packages which are capable of communicating with the systems of major control manufacturers. Care must be taken to specify that the control manufacturers and the integrator's systems must are compatible.

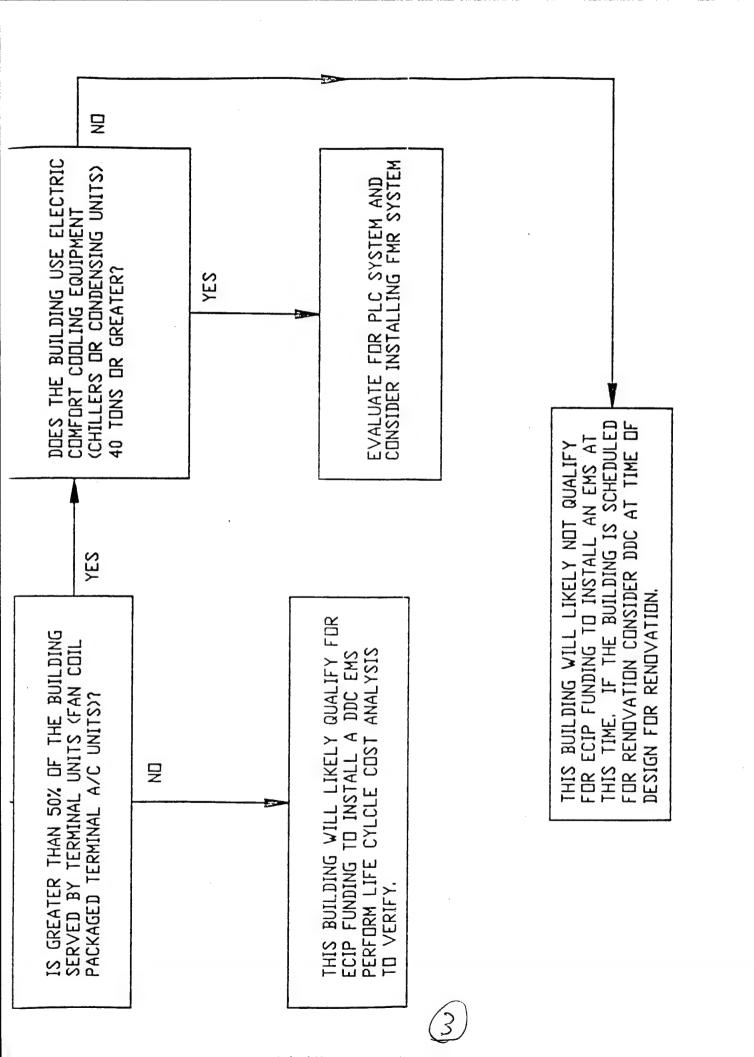
For small buildings which are served primarily by perimeter fan-coil units and central air cooled chilled water, and district steam heated hot water systems the PLC should be considered as an option for maximum energy savings while meeting ECIP funding criteria. These PLC systems should be limited in use to smaller buildings up to 20,000 sq. ft. and two stories or less with simple AC power distribution systems. The PLC systems have reportedly experienced operating problems when connected to AC power system which have a high level of electronic equipment usage. The availability of competitive vendors is limited and care should be taken when selecting systems to chose vendors with a documented history of successful installations similar to the application being considered.

The results of this study can also be extrapolated to assist energy auditors in selecting buildings for EMS implementation. The flow chart on the following page can be used as a preliminary test in selecting these buildings.

EMS BUILDING EVALUATION FLOWCHART







Because the recommended control strategy for DDC installation involves Installation-wide systems, it may be necessary to implement these systems in buildings which do not show a payback. This is true because the goal is to maximize the energy savings for the entire Installation.

G. TABULATION OF RESULTS

Tables 2 on page I-11, Table 3 on page I-12 and Table 4 on page I-13, list the results of the energy conservation analyses for each investigated Energy Conservation Opportunity (ECO). In addition, the EMS Capability Summary Tables compare the features of each system and their advantages and disadvantages relative to each building studied.

Life Cycle Cost Analysis Summary Sheets are included for all developed projects meeting ECIP Criteria.

TABLE 2

		TOTAL	INITIAL		SIMPLE	TOTAL	
BUILDING	ECO	SAVINGS	INVESTMENT	SIR	PAYBACK	ENERGY	REMARKS
		69	€4		YEAR(S)	SAVINGS KBTU	
	FMR	14,909	1,115	13.37	1	0	
Building 200	PLC	59,601	12,711	4.69	3	981,343	
	DDC	152,246	78,764	1.93	5	1,489,047	
	FMR	14,979	1,673	8.95	1	0	
Building 219	PLC	91,836	12,516	7.34	2	1,583,582	
	DDC	146,518	72,141	2.03	5	1,725,602	
	FMR	26,923	558	48.29	1	0	
Building 247	PLC	108,303	14,914	7.26	2	1,837,268	
	DDC	166,883	87,416	1.91	5	2,043,868	
	FMR	3,999	558	7.17	2	0	
Building 1425	PLC	17,893	11,518	1.55	9	297,889	*
	DDC	33,374	48,993	89.	•	312,251	*
	FMR	3,999	558	7.17	2	0	
Building 3136	PLC	17,938	10,464	1.68	9	294,780	
	DDC	32,715	48,614	19.	•	322,978	

*As noted in Section III D, these figures are not applicable to Building 1425 because it is currently equipped with an EMS. These figures are for comparison to buildings which are similar but are not equipped with an EMS.

TABLE 3

		(A) ANNUAL ELECTRICAL	(B) ANNUAL ELECTRICAL	© ANNUAL NATURAL	(D) ANNUAL NATURAL	(E) ANNUAL DISTRICT	(F) ANNUAL DISTRICT	(G) ANNUAL ELECTRICAL	(H) TOTAL ANNUAL
BUILDING	ECO	ENERGY	COST	GAS	GAS	STEAM	STEAM	DEMAND	COST
		SAVINGS	SAVINGS	SAVINGS	SAVINGS	SAVINGS	SAVINGS	SAVINGS	SAVINGS
		kWh	69	THERM	69	KLBS	€9	89	69
			$(A \times \$.02)$		(C x \$.608)		$(E \times $8.0)$		(B+D+F+G)
	FMR	0	0	0	0			1,700	1,700
Building 200	PLC	956,09	1,219	7,733	4,702			0	5,921
	DDC	99,545	1,991	11,493	886'9	****		1,700	10,679
	FMR	0	0		0			1,708	1,708
Building 219	PLC	207,057	4,141	8,778	5,337			0	9,478
	DDC	225,961	4,519	9,553	5,808	****	***	1,708	12,035
	FMR	0	0		0	****		3,070	3,070
Building 247	PLC	195,215	3,904	11,710	7,120			0	11,024
	DDC	218,186	4,364	12,992	7,899			3,070	15,333
	FMR	0	0			0	0	456	491
Building 1425	PLC	16,374	328			180	1,440	0	1,768
	DDC	19,208	384	***		184	1,472	456	2,312
	FMR	0	0			0	0	456	456
Building 3136	PLC	10,104	202			194	1,552	0	1,754
	DDC	13,890	278			206	1,648	456	2,382

18% 27% %0 28% 31% %0 17% %61 0% 24% 25% %0 %81 PERCENTAGE SAVINGS ENERGY 0 981,343 297,889 322,978 0 312,251 1,489,047 1,583,582 1,725,602 1,837,268 2,043,868 294,780 SAVINGS ENERGY ANNUAL **kBT**U 949,675 1,247,564 4,493,455 3,861,809 5,474,798 5,474,798 3,985,751 5,587,411 5,587,411 4,003,829 10,988,125 935,313 1,439,356 10,988,125 9,150,857 8,944,257 1,247,564 1,762,334 1,762,334 1,467,554 ENERGY USAGE ANNUAL **kBT**U BASELINE BASELINE BASELINE BASELINE BASELINE DDC FMR **FMR** DDC FMR DDC FMR ECO PLC PLC PLC FMR PLC DDC PLC DDC **Building 3136 Building 1425** Building 200 Building 219 Building 247 BUILDING

TABLE 4

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling	:	X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	Х
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		Х	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			

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FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	х	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		х	X
Flexibility		Х	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Criteria			

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ENIS Capability Sulfillinary - Building 1425		I	<u> </u>
FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset	N/A	N/A	N/A
Enthalpy Economizer	N/A	N/A	N/A
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			X

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FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset	N/A	N/A	N/A
Enthalpy Economizer	N/A	N/A	N/A
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets Funding Criteria	X	X	
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			X

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LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

	Ft. Belvoir EMS Study	FISCA	ECT NO. <u>DACA-31</u> . AL YEAR <u>95</u>	92 D0061 Del. Ord	<u>ler 4</u>	
	ION NAME: BUILDING 2				CIP No	
ANALYSIS D		NOMIC LIFE: 10	YEARS PR	EPARER: <u>EINH</u>	ORN YAFFEE PRESCO	Ш
	STMENT COSTS:					
	JCTION COST			\$70,640		
B. SIOH				\$4,238		
C. DESIGN C				\$3,885		
	OST (1A+1B+1C)					
	VALUE OF EXISTI		***************************************			
	TILITY COMPANY F					
G, TOTAL IN	VESTMENT (1D-1E	-1F)		\$78,763		
2 ENEDGY	CAVINGE (VCOCT	():				
	SAVINGS (+)/COST		ACTORS (O	s+ 4004\\	DISCOUNT RATE: 3	10/
DATE OF NE	STIR -4942-1 USED	FOR DISCOUNT FA	HCTORS (OC	<u>:t 1994)) </u>	DISCOUNT RATE: 3	1.1%
	COST	SAVINGS	ANNUAL \$	DISCOUN	NT DISCOUNTED)
ENERGY	\$ / MBTU (1)	MBTU / YR (2)	SAVINGS (3			
				<u> </u>		
A. ELEC	5.86	339.7	\$1,991	8	3.82 \$17,561	l
B. DIST	5.97					
C. RESID						
D. NG	6.08	1149.3	\$6,988	9	9.86 \$68,902	2
G.						
H. DEMAND	SAVINGS	_	\$1,700		8.49 \$14,433	3
I. TOTAL			\$10,679		\$100,896	3
3. NO	N-ENERGY SAVING	S (+) OR COST (-):				
A. ANI	NUAL RECURRING	(+/-)	\$5,56	80		
(1) DIS	COUNT FACTOR (T	ABLE A)		8.4	19	
(2) DIS	COUNTED SAVING	S/COST (3A X 3A1)	1		\$47,20	4

B.	NON-RECURRING SAVINGS (+) OR COST (-)					
		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED	
а.	***************************************					\$0
b.					\$0	
C.						\$0
d.	TOTAL	\$0				\$0
C.	. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4)					\$61,637
_4	SIMPLE PAYBACK (1G / (2/3+3A+ (3Bd1 / ECONOMIC LIFE))):			4.9	YEARS	
5.	TOTAL NET DISCOUNTED SAVINGS (215+3C):			\$148,100		
6;	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):				1.88	
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):			9.82%		

1 NOVEMBER 1995

LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

PROJECT TI	TLE: Ft. Belvoir EM		PROJECT NO. <u>DAC</u> FISCAL YEAR <u>95</u> MS INSTALLATION		
ANALYSIS DAT				R: EINHORN YAFF	
1. INVES	TMENT COSTS:				
A. CONS	TRUCTION COST		\$64,70	0	
B. SIOH			\$3,88	2	
C. DESIG	N COST		\$3,55	9	
D. TOTAL	COST (1A+1B+1C)				
E. SALVA	GE VALUE OF EXIS	TING			
F. PUBLIC	UTILITY COMPAN	Y REBATE			
G. TOTAL	INVESTMENT (1D-	1E-1F)	\$72,14	1	
2. ENERG	BY SAVINGS (+)/CO	ST(-):			
DATE OF NISTI	R -4942-1 USED FO	R DISCOUNT FACT	ORS (Oct 1994))	DISCOUNT	RATE: 3.1%
	COST	SAVINGS	ANNUAL \$	DISCOUNT	DISCOUNTED
ENERGY	\$ / MBTU (1)	MBTU / YR (2)	SAVINGS (3)	FACTOR (4)	SAVINGS (5)
A. ELEC	5.86	770.3	\$4,514	8.82	\$39,813
B. DIST	5.97				
C. RESID					
D. NG	6.08	955.3	\$5,808	9.86	\$57,267
G. OTHER			 		
H. DEMAND SA	VINGS		\$1,708	8.49	\$14,501
I. TOTAL			\$12,028		\$111,581
3. NON-E	NERGY SAVINGS (-	+) OR COST (-);			
A A A A A A A A A A A A A A A A A A A	u proupping :				
	AL RECURRING (+/-		\$3,710	0.40	
	UNT FACTOR (TAB	-		8,49	\$31,498
(2) 01000) DISCOUNTED SAVINGS/COST (3A X 3A1)				φ31,430

ADJUSTED INTERNAL RATE OF RETURN (AIRR):

10.40%

В.	NON-RECUR	RING SAVINGS (+)	OR COST (-)		
******		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
<u>a.</u>					\$0
b.					\$0
C.					\$0
d.	TOTAL	\$0			\$0
C.	TOTAL NON	ENERGY DISCOUN	\$45,999		
4.	SIMPLE PAYBACK (1G / (2/3+3A+ (3Bd1 / ECONOMIC LIFE))):				4.6YEARS
5.	TOTAL NET DISCOUNTED SAVINGS (2N5+3C):				\$143,079
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):				1.98

1 NOVEMBER 1995

LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

PRO.	JECT TIT	Ft. Beivoir, VA LE: <u>Ft. Belvoir EM</u> DRTION NAME: <u>BU</u>		_ FISCAL Y	EAR <u>95</u>		Del. Order 4
ANALYS	SIS DATE	: <u>1/95</u> ECONO	MIC LIFE: 10	YEARS F	PREPARER	: EINHORN YAF	FEE PRESCOTT
_1	INVEST	MENT COSTS:					
Α.	CONST	RUCTION COST			\$78,400		
В.	SIOH				\$4,704		
C.	DESIGN	COST			\$4,312		
D.	TOTAL	COST (1A+1B+1C)					
E	SALVAG	E VALUE OF EXIS	TING				
F.	PUBLIC	UTILITY COMPAN	Y REBATE				
G.	TOTAL	NVESTMENT (1D-	1E-1F)		\$87,416		
2	ENERG'	Y SAVINGS (+)/CO	ST(-):				
DATE O	F NISTIR	-4942-1 USED FO	R DISCOUNT FAC	TORS (O	ct 1994))	DISCOUN	T RATE: 3.1%
		COST	SAVINGS	ANNU	AL\$	DISCOUNT	DISCOUNTED
ENERG'	<u>Y</u>	\$ / MBTU (1)	MBTU / YR (2)	SAVIN	GS (3)	FACTOR (4)	SAVINGS (5)
A. ELEC	` -	5.86	744.7	\$4,	364	8.82	\$38,490
B. DIST		5.97		-			
C. RESI	<u>D</u> _						
D. NG		6.08	1299.2	\$7,	899	9.86	\$77,884
G. OTHE	ER _						
H. DEM	AND SAV	INGS		\$3,	070	8.49	\$26,064
I. TOTAL	<u> </u>		2044	\$15,	333		\$142,438
3.	NON-EN	IERGY SAVINGS (1	-) OR COST (-):				
Α.		RECURRING (+/-)		\$2,	300		
(1)		INT FACTOR (TABI		_	_	8.49	
(2)	(2) DISCOUNTED SAVINGS/COST (3A X 3A1)						\$19,527

В.	NON-RECUF					
		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS	s(+)
			OCCOH. (2)	PACTOR(3)	<u> </u>	
a.					\$0)
b.					\$0	1
C.		-		•	\$0	1
d.	TOTAL	\$0			\$0)
C.	TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4)				\$19,527	,
4.	SIMPLE PAYBACK (1G / (213+3A+ (3Bd1 / ECONOMIC LIFE))):				5.0YEARS	
5.	TOTAL NET DISCOUNTED SAVINGS (215+3C):			\$161,965		
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):				1.85	
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):			7.65%		

LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

IS Study	FISCAL YEAR95		
MIC LIFE: 10 YE	ARS PREPARER	R: EINHORN YAFF	EE PRESCOTT
	\$10,330		
· · · · · · · · · · · · · · · · · · ·	\$620	<u>) </u>	
	\$568	3	
TING			
Y REBATE			
1E-1F)	\$11,518	3	
ST(-):			
R DISCOUNT FACTO	ORS (Oct 1994))	DISCOUNT	RATE: 3.1%
SAVINGS	ANNUAL \$	DISCOUNT	DISCOUNTED
MBTU / YR (2)	SAVINGS (3)	FACTOR (4)	SAVINGS (5)
55.9	\$328	8.82	\$2,893
			
242.0	\$1,4/1	9.86	\$14,504
			\$0
200	£1 700		\$17,397
290	<u> </u>		\$17,337
A OR COST ():			
F) OH COST (-).			
	40		
	<u> </u>		
			\$0
	IS Study ILDING 1425 - PLC E MIC LIFE: 10 YE STING Y REBATE 1E-1F) ST(-): R DISCOUNT FACTO SAVINGS	## Study	S Study

В.	NON-RECUP	RRING SAVINGS (+)				
		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED) SAVINGS(+)
a						\$0
b.						\$0
C.						\$0
d.	TOTAL	\$0				\$0
C.	TOTAL NON	ENERGY DISCOUN		\$0		
_4	SIMPLE PAYBACK (1G / (2/3+3A+ (3Bd1 / ECONOMIC LIFE))):				6.4	YEARS
5,	TOTAL NET DISCOUNTED SAVINGS (215+3C):			\$17,397		
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):				1.51	
7	ADJUSTED INTERNAL RATE OF RETURN (AIRR):			7.44%		

1 NOVEMBER 1995

LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

PROJECT		IS Study	PROJECT NO. DAG FISCAL YEAR 95 EMS		Del. Order 4
ANALYSIS DA	ATE: 1/95 ECONOM	MICLIFE: 10 YE	ARS PREPARE	R: EINHORN YAFF	EE PRESCOTT
1. INVE	STMENT COSTS:				
A. CON	ISTRUCTION COST		\$50	0	
B. SIO	1		\$3	0	
C. DES	IGN COST		\$2	8	
D. TOT	AL COST (1A+1B+1C)				
E. SAL	VAGE VALUE OF EXIS	STING	***		
F. PUB	LIC UTILITY COMPAN	Y REBATE			
G. TOT.	AL INVESTMENT (1D-	1E-1F)	\$55	8	
2. ENE	RGY SAVINGS (+)/CO	ST(-):			
DATE OF NIS	TIR -4942-1 USED FO	R DISCOUNT FACTO	ORS (Oct 1994))	DISCOUNT	RATE: 3.1%
	COST	SAVINGS	ANNUAL \$	DISCOUNT	DISCOUNTED
ENERGY \$ / MBTU (1)		MBTU / YR (2)	SAVINGS (3)	FACTOR (4)	SAVINGS (5)
A. ELEC	5.86	0	\$0	8.82	\$0
B. DIST	5.97				
C. RESID		***************************************			
D. NG	6.08	0	\$0	9.86	\$0
G. OTHER					
H. DEMAND	SAVINGS		\$456	8.49	\$3,871
I. TOTAL		0	\$0		\$3,871
3. NON	I-ENERGY SAVINGS (-	+) OR COST (-):			
	UAL RECURRING (+/-		\$0		
	COUNT FACTOR (TAB		-	8.11	
(2) DISC	COUNTED SAVINGS/C	OST (3A X 3A1)			\$0

B. NON-RECURRING SAVINGS (+) OR COST (-)

		SAVINGS (+)	YEAR OF	DISCOUNT	DISCOUNTED SAVINGS(+)	
		COST (-) (1)	OCCUR. (2)	FACTOR(3)	COST(-) (4)	_
<u>a.</u>					\$0	_
<u>b.</u>	***				<u>\$0</u>	
<u>C.</u>					<u>\$0</u>	
d.	TOTAL	<u>\$0</u>			\$0	
C.	TOTAL NON	ENERGY DISCOUN	<u>\$0</u>			
4.	SIMPLE PAY	BACK (1G / (213+3A	1.2YEARS			
_5.	TOTAL NET DISCOUNTED SAVINGS (2N5+3C):				<u>\$3.871</u>	
6;	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):				6.94	
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):				22.7%	

1 NOVEMBER 1995

FORT BELVOIR, VIRGINIA

1 NOVEMBER 1995

LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

PROJE	ION: Ft. BOIVO CT TITLE: Ft. ETE PORTION	Belvoir EMS		<u>F</u>	ISCAL YEAR		1-31-92 D006 ECIP		<u> </u>
	DATE: 1/95	ECONON				PARER:	EINHORN Y		SCOTT
1. IN	NVESTMENT C	OSTS:							
A. C	ONSTRUCTIO								
B. S	ЮН					\$30			
C. D	ESIGN COST					\$28			
D. T	OTAL COST (1	A+1B+1C)							
E. S	ALVAGE VALU	E OF EXIS	TING						
F. P	UBLIC UTILITY	COMPANY	REBATE						
G. T	OTAL INVEST	MENT (1D-1	E-1F)			\$558			
2. E	NERGY SAVIN	GS (+)/COS	ST(-):						
DATE OF	NISTIR -4942-1	USED FO	R DISCOUN	NT FACTO	RS (Oct 1	994))	DISCO	UNT RATE:	3.1%
	CC	OST	SAVING	as	ANNUAL	\$	DISCOUNT	r disc	COUNTED
ENERGY	\$/MB1	U (1)	MBTU/	/R (2)	SAVINGS	3 (3)	FACTOR (4) SAV	NGS (5)
									•
A. ELEC	_	5.86		0	\$0)	8.82	<u> </u>	\$0
B. DIST		5.97							
C. RESID									***
D. NG		6.08		0	\$0)	9.86	<u> </u>	\$0
G. OTHER	ID SAVINGS				\$456		8.49	9	\$3,871
I. TOTAL	ID SAVINGS			0	\$(0.43		\$3,871
1. TOTAL					Ψ				\$0,07 1
3 N	ION-ENERGY	SAVINGS (4	OR COST	Γ (-\·					
	ON ENERGY.	S/TVITCO (1	1011000						
A. A	NNUAL RECU	RRING (+/-)			\$0				
(1) DISCOUNT FACTOR (TABLE A)							8.11	_	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)									\$0

ADJUSTED INTERNAL RATE OF RETURN (AIRR):

22.7%

<u>B.</u>	NON-RECUR	RING SAVINGS (+)	OR COST (-)		
		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
<u>a</u> .				· · · · · · · · · · · · · · · · · · ·	<u>\$0</u>
<u>b.</u>					\$0
<u>c.</u>					<u>\$0</u>
d.	TOTAL	<u>\$0</u>			<u>\$0</u>
C.	TOTAL NON	\$0			
4.	SIMPLE PAY	BACK (1G / (213+3A	1.2 YEARS		
5,	TOTAL NET	DISCOUNTED SAVI	<u>\$3.871</u>		
6:	SAVINGS TO	INVESTMENT RAT	6.94		

II. INTRODUCTION

A. PURPOSE

The purpose of this study is to compare three different types of energy management systems and determine which system would be most effective in each of a variety of different buildings. The three systems chosen for this analysis are the FM Relay (FMR), Power Line Carrier (PLC) and Direct Digital Control (DDC) systems. The analysis performed was based upon five buildings of different function, occupancy, and scheduling as well as different types of mechanical systems. The recommendations listed in this report are to be applied over the entire Installation using the criteria listed for evaluating each building. This study will develop the recommended strategies for applying energy management systems (EMS) to many of the buildings at Ft. Belvoir.

B. METHODOLOGY

The analysis portion of this study is based on field surveys which were conducted over a two month period. All five buildings were surveyed and mechanical equipment and control information was documented. In addition to surveys, operating personnel and occupants were interviewed to determine the hours of usage and occupant densities. Interviews were also conducted with personnel from the energy management department at Ft. Belvoir, who operate the existing FMR system.

Each EMS type was analyzed to determine its costs, capabilities, maintenance requirements and applicability to each building. The results of this analysis are shown in an EMS Evaluation Matrix for each building and system type.

Several energy simulations were performed for each building to estimate the energy usage under different operating scenarios. For each building, a baseline simulation was performed to estimate the energy usage under the current operating conditions, and for all buildings a second simulation was performed to estimate the energy usage with an energy management system in place. Each EMS is described in Section III and the energy analysis inputs reflect the description and points list given for each system. All building simulations were performed using the **Carrier E20-II Hourly Analysis 3.04** computer program and the following parameters:

- The physical properties such as floor area, wall and roof construction, window types and sizes, lighting density, occupancy, and equipment heat gains were taken from available construction documentation and verified by field surveys. Where construction drawings were not available, the information was assumed based on known field conditions, typical building practices, and engineering judgement.
- Outside air quantities were original design values unless these numbers were not
 available. In these cases the values were estimated based upon louver sizes, supply
 and return fan capacity comparisons and coil entering conditions.

- Electric rates were based on the actual electric consumption charges of \$0.01968/kWh charged by Virginia Power. Demand charges were calculated separately as described later in this section.
- All heating fuel consumption costs are based on natural gas rates from Washington Gas and district steam heating rates as established by Ft. Belvoir, where applicable.
- For hydronic two pipe change-over systems, the cooling season is May through September with the heating season being all other times of the year. This is based on estimated change-over dates provided by Ft. Belvoir.
- The weather data used in all energy calculations was from Washington, DC because this is the closest geographical city for which the Carrier program includes the necessary data. It is assumed that the 1° F average difference in the monthly mean temperature between the Washington, DC and Ft. Belvoir conditions will not have a significant impact on the outcome of these calculations.

In addition to the computerized energy simulation, several analyses were performed to estimate the magnitude of savings from the improved control accuracy and electric demand limiting capabilities of DDC control systems. These factors where evaluated as follows:

- The increased control accuracy associated with the DDC systems will result in an increased operating efficiency for each of the buildings as compared to the existing control system. This is true because the DDC system will maintain setpoints more accurately and respond to condition changes more quickly than the existing pneumatic control systems which are typically slow at performing control logic functions and lose their calibration over time. The energy simulation program is not capable of accounting for these differences in control accuracy. It was assumed that the inaccuracies of the existing pneumatic control systems will result in an additional energy usage of approximately 5% in each building. This additional energy usage was reflected by increasing the estimated energy consumption values for the Baseline, FMS and PLC conditions by 5% before entering them into the Life Cycle Cost Analysis (LCCA) program (See Appendix K for Calculations).
- The energy simulation program is not capable of estimating the potential cost savings associated with electrical demand limiting capabilities of the EMS analyzed in this study. The potential demand savings was estimated for each building based on the example shown in figure 2.1. This savings figure was then reflected in the life cycle cost analysis by entering the value as a demand charge for the Baseline and PLC conditions, which do not include demand limiting capabilities.

Figure 2.1 Electrical Demand Limiting Strategy:

An effective strategy for demand limiting on a multi-building Installation such as Fort Belvoir is to cycle off groups of equipment during periods of high electrical demand. An example of this strategy would be to connect ten chillers to an EMS. Each chiller

would be cycled off for a period of fifteen minutes in a rotating sequence with the other chillers in the group. Utilizing this strategy, power demand could be reduced by the total kW requirement of the smallest chiller in the group. During a five hour period, any one chiller would be cycled off for no more than two fifteen minute periods. With this strategy, the demand savings attributable to any group of buildings or chillers is determined by the unit or building with the smallest electric demand which is being cycled off. For this reason groups should be selected so that the electric demand for the equipment being cycled of is approximately equal for all buildings in the group. A group of ten nominal forty ton air cooled packaged chillers with a power requirement of 55.7 kW each, when cycled in accordance with this strategy, can result in a cost savings as follows:

- 55.7 kW x \$12.54/kW demand charge/month
- = \$698.5/month x 12 months/year
- = \$8382/year.

Because nine other chillers or buildings are necessary to make this strategy feasible without out a major effect on occupant comfort, the total savings attributable to one chiller or building would be 1/10 of the total or \$838.2/year. The demand savings were reflected in the economic analysis as a demand charge for the Baseline and PLC conditions, which do not include demand limiting capabilities.

The results of the building simulations along with initial investment, maintenance costs, and demand savings were used to perform Life Cycle Cost Analysis (LCCA) for EMS implementation in each building. All LCCA were performed using **NIST Building Life** Cycle Cost (BLCC) 4.0 computer program with the following parameters:

- A 10 Year study period was used, as established by the ECIP guidelines.
- The Discount Rate is 4.0%, as defined by ECIP Guidelines for 10 Year Studies.
- The Energy cost price escalation rates are based on DOE figures for industrial applications in the State of Virginia as specified by ECIP Guidelines.

An evaluation matrix was developed to compare the relative merits of the different EMS for each building. Because the FMR system provides only demand limiting capabilities and is not a comprehensive EMS it was not entered in the matrix. The following example represents the maximum values assigned to each feature used to evaluate the EMS:

Energy Management System Evaluation Matrix

FUNCTION	EMS
Hot Water Reset	1
Supply Air Reset	1
Chilled Water Reset	1
Enthalpy Economizer	2
Time of Day Scheduling	10
Demand Limiting (Installation Wide)	2
Centralized Control	2
Centralized Monitoring	2
Expandability	2
Flexibility	2
Maintenance Scheduling	2
Optimum Start	2
Occupant Control/Override	1
Comfort Control	2
Reliability/Maintainability	2
Effect on Equipment Life	2
Maintenance Costs	2
Savings to Investment Ration (SIR)	10
Total	48

This matrix is intended to provide a relative comparison of the different EMS features. The maximum values shown above were assigned based on an assumption of the relative importance of the features listed. Items which are result in direct energy and/or money savings were given the highest values, while items which result in indirect savings or increases in system performance were given lower values. The outcome of the matrix, as well as the results of the building simulations and life cycle cost analysis, were used to formulate the recommendations listed for each building. Each recommendation was then evaluated for ECIP compliance and the results of those evaluations are listed in Table 1 in the Executive Summary portion of this report.

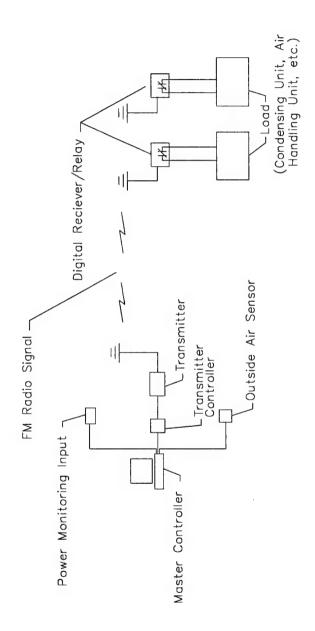
C. EMS SYSTEM DESCRIPTIONS FM Relay (FMR) EMS Systems

The FMR system utilizes FM radio signals for communication between the centralized control location and individual equipment controllers. Each piece of equipment to be controlled is equipped with a digital receiver/relay which interlocks with the unit control system or incoming power supply. The relay can be used to interrupt the power to the piece of equipment or to interrupt the control signal, thus allowing remote start-stop control of the equipment. Figure 2.2 on page II-6 shows a schematic diagram of a typical FMR system. This system can be used effectively to provide simple automatic time scheduling and demand limiting for packaged commercial and residential HVAC equipment and lighting. A computer controls the time schedule for the operation of equipment and also cycles each piece of equipment as necessary to limit electric demand to a certain preset target value.

Priorities for load shedding are preset and the computer can select the appropriate cycling rate based on a variety of available input data or the cycling rate can be set manually by the operator. The system can be configured to receive electric demand information directly from a sub-station demand meter or from a series of contacts indicating that the demand status is above or below the target value. Cycling rates may also be controlled based on outside air temperatures, because a rise in electrical demand typically coincides with an increase in outside temperatures.

The FMR does not provide any temperature or safety control for the HVAC system, it will only enable or disable the equipment to which it is attached. The existing building control system must be maintained to perform all temperature and safety control functions. There is also no user over-ride function for this type of system.

Figure 2.2: FM Relay System Schematic



This type of system is currently used most often by utility companies to limit the electrical demand on their distribution network by cycling air conditioning systems and water heaters in residences and small commercial establishments.

A <u>Scientific Atlanta</u> FMR system is currently in operation at Fort Belvoir and is used for demand limiting in most of the housing units and approximately twenty administrative and support buildings. The installation of a new PC based master controller has greatly enhanced the system capacity and capabilities. The system is now capable of supporting 2094 different address codes and will accept contact closure, analog and/or pulse input data. The Installation is currently utilizing only a fraction of the available address codes, leaving a great deal of room for expansion of this system.

Due to the fact that the FMR operates on a one way communication principal and cannot be integrated into a total building HVAC control system it should be utilized only for on/off control of major HVAC components for demand limiting. The systems can be used very effectively to turn off HVAC equipment such as chillers and cooling tower fans for short periods of time to control electrical demand in a building or multiple building Installation. Figure 2.1 on page II-2 shows and example of an effective peak shaving strategy for a multiple building Installation such as Ft. Belvoir.

Power Line Carrier (PLC) EMS Systems

The PLC type control system is one in which the communication between components of the system takes place over the buildings electrical distribution wiring. This system utilizes a transmitter or encoder to generate a high frequency signal which is transmitted through the building wiring where it is received by the appropriate receiver and used to turn equipment on or off. The controller which initiates the control signals can be interfaced with a computerized energy management program which can provide time scheduling and demand limiting based on several parameters, including time of day, ambient temperatures and electric demand levels. These input parameters can only received from within the building being controlled. The typical PLC controller is not capable of communicating over a wide area network with other systems or centralized power monitoring equipment. Access is limited to "dial-up" modem communication with other controllers of similar configuration. Equipment can be controlled on an individual basis, or by electrical circuit if several units are connected to the same branch circuit or panel board. These systems can also be used to control lighting. The flexibility of this system depends greatly upon the configuration and condition of the existing building electrical system. For example, if all of the fan coil units for each floor of the building are served from a dedicated panel, that floor can be controlled as one zone by utilizing only one receiver relay.

The level of control that the PLC systems is capable of providing depends upon the power and sophistication of the controlling computer. There are variety of software packages available, each with different levels of control capability. Lower level systems provide on/off control based on manual inputs or simple time of day scheduling. Higher level systems can receive input information directly from demand

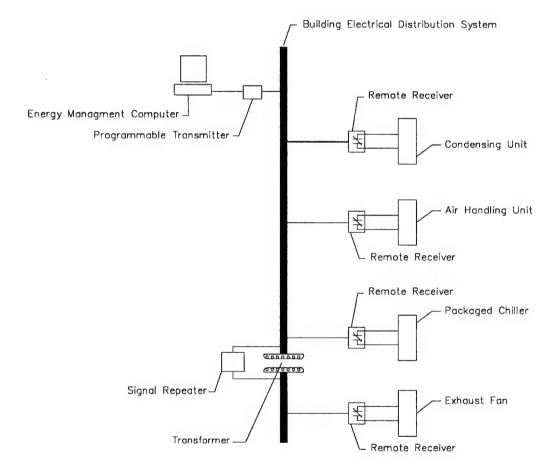
FORT BELVOIR, VIRGINIA

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metering equipment and through two way communication, monitor and track space conditions and equipment status.

Based on several factors including availability, competition and service support, it was decided for the purposes of this study that a computer controlled, on/off system would be evaluated. See Figure 2.3 on page II-9 for a typical system schematic. It should also be noted that this configuration represents the most popular usage of PLC systems in the industry today and therefore offers the best opportunity for competitive bidding. The PLC will not take the place of the existing building control system which must be maintained to provide all temperature and safety control functions.

Figure 2.3: Power Line Carrier System Schematic:



This system offers a lower level of control, monitoring, and flexibility than the DDC system.

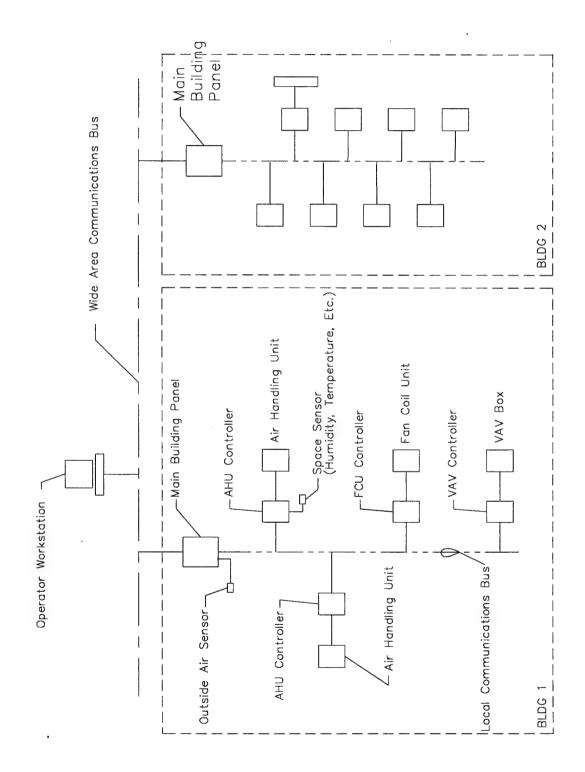
Direct Digital Control (DDC) EMS Systems

A DDC system is one that typically uses a series of stand-alone controllers which are linked together in a network arrangement by use of a local communications bus. Each controller serves an individual piece of equipment such as an air handling unit, VAV box, or fan coil unit and is programmed to perform the control function independent of the other network components. The local bus provides means to collect, store, and analyze data from the controllers using network controllers or control units. See Figure 2.4 on page II-11 for a typical system schematic. These control units can provide a variety of energy management functions such as optimal start, demand limiting, water and air temperature reset as well as trend logging functions such as run time totalization and space temperature data. The network controllers can also be interlocked with other network controllers in the same building or in other buildings using a separate communications bus. This communications bus can be used to interlock several buildings at one or more sites and provide access to all of the control system components by use of an operator workstation. From the operator workstation an operator may change the setpoints and time schedules for all of the equipment connected to the system. In addition, the operator workstation can be used to store, access and output historical data which can be used for maintenance scheduling and troubleshooting of the HVAC systems. In most systems, software is available which can be used to schedule maintenance activities based on run time, elapsed time, or other operating parameters such as dirty filters.

This system offers the highest level of control, monitoring and flexibility of all systems described in this report. It is also the system most widely used in the commercial building market today. The DDC system offers the advantage of "Add-On" capabilities which allows a basic system to be continually upgraded as funding or operational requirements dictate. Because the system uses a series of twisted pair communications busses, additional points can typically be added with only a minimum of new wiring.

The building control industry along with the many major HVAC equipment manufacturers and various professional organizations are currently participating in cooperative efforts to form open protocol standards for direct digital controls in building systems. While the goal of compatibility between competing brands of control systems is not expected for the next 5 to 10 years, this effort has already resulted in a number of agreements which allow building control systems to interface with DDC components in major mechanical and electrical equipment. There are also companies which offer interface software to allow different brands of systems to be monitored and controlled with a single PC workstation.

Figure 2.4: DDC System Schematic



III. BUILDING ANALYSIS

A. BUILDING 200 - ENLISTED MEN'S SERVICE CLUB

Existing System Description

The existing mechanical system for this building consists of six constant volume, central station air handling units, one water chiller with two remote air cooled condensing units, one boiler, five pumps and several exhaust fans as well as cabinet unit heaters in each of two entrance vestibules and hot water fin-tube radiation at various areas on the perimeter of the building.

Five of the six air handling units have both hot water heating and chilled water cooling coils with three-way pneumatic control valves and are served by a remote return air fan. All five are equipped with pneumatically operated supply, return and relief dampers which are controlled by a remote mounted manually adjustable position control. The units are not equipped with economizer controls to allow for use of outside air for cooling during periods of mild weather. Two of these air handlers are multi-zone units with pneumatic zone dampers while the three are single zone units. The sixth air handling unit is heating and ventilating unit with a hot water heating coil and is ducted for 100% outside air with no return air capabilities. This unit (AHU-6) was originally designed to serve a kitchen facility which has been reduced to a small food preparation area with one small exhaust hood a small dish washing area with an exhaust hood while the remaining area has been converted to a travel office.

The chiller provides the cooling water for the entire building with a primary chilled water pump circulating the chilled water to the five cooling/heating air handling units. Each condensing unit serves a single refrigerant circuit with-in the chiller and is controlled by a thermostat which senses chilled water supply temperature. The chiller operates using refrigerant R-22.

Hot water for heating is provided by an oil fired boiler operating on a hot water reset schedule which adjusts the supply temperature based on the outside air temperature. The pumps which circulate the chilled and hot water are controlled through motor starters which are equipped with Hand-On-Automatic (HOA) switches.

Analysis of EMS Options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

2 - 60 Ton Air Cooled Chillers

1 Compressor @ 211 Amps, 200 Volts, 3 Phase 211 x 200 x $\sqrt{3}$

= 73093 Volt-Amps (VA) per chiller

6 Fan Motors @ 1.5 Horsepower (10 Amps, 230 Volts, 1 Phase)

6 x 10 x 230

= 13800 VA per chiller

73093 VA + 13800 VA

= 86893 VA per chiller

86893 VA x 0.65 (Average Power Factor)

= 56480 Watts/Chiller

56480 Watts/Chiller x 2 Chillers x 1kW/1000 Watts

- = 113 kW
- = 113 kW x \$12.54/kW demand charge/month
- = \$1417/month x 12 months/year
- = \$16999/year / 10 buildings
- $= \frac{$1700}{\text{year}}$

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on each of two condensing units (ACCU-1 and ACCU-2) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately \$1115 and result in an estimated savings of \$14,909 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 13.37 and a payback period of 1 year.

ECO #2 PLC: The PLC system which was evaluated for this building includes start/stop control of the air handling units, chillers and pumps. PLC relays would be interlocked with the motor starters on supply and return fans of each air handling unit, as well as the motor starters for each pump and to the remote start/stop contacts (if present) on the air cooled condensing units of the chiller. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modern connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a list of control points for this system:

PLC POINTS LIST

Building - 200

Point Description		Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Air Handling Units (Typ. o	of 5)			
Supply Fan Start/Stop		X		
Return Fan Start/Stop		X		
Outside Air Damper Open/Close			X	
Air Handling Units (100% out	side air)			
Supply Fan Start/Stop		X		
Outside Air Damper Open/Close			X	
Split Air Cooled Chille	r			
Condensing Unit Enable/Disable	(Typ. of 2)		X	
Chilled Water Pump Start/Stop		X		
Boiler				
Burner Enable/Disable				X
Hot Water Pump Start/Stop		X		
Standby Pump Start/Stop		X		
Radiant Heating Pump Start/Stop		X		

The system as described above will require an initial investment of approximately \$12,711 and result in an estimated savings of \$59,601 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 4.69 and a payback period of 3 years.

ECO #3 DDC: This system would include stand-alone controllers for each air handling unit, boiler and chiller, which are capable of time of day scheduling, night setback and historical data logging. In addition the controller for the boiler will be capable of resetting the hot water supply temperature based on the outside air temperature. Each controller would be tied to a stand-alone building control panel which is capable of demand limiting and optimum start functions as well "dial-up access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a list of control points for this system:

DDC POINTS LIST

Building - 200

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Single Zone Air Handling Units (Typ. of 3)				
Mixed Air Enthalpy		X		
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Return Fan Start/Stop			X	
Supply Fan Status	X			
Return Fan Status	X			
Hot Water Valve				X
Chilled Water Valve				X
Supply Air Temperature		X		
Space Temperature		X		
Multi-zone Air Handling Units (Typ. of 2)				
Same as above				
Zone Dampers				X
Hot Deck Supply Temperature		X		
Cold Deck Supply Temperature		X		
Single Zone - 100% Outside Air (AHU-6)				
Outside Air Temperature		X		
Supply Fan Start/Stop			X	
Supply Fan Status	X			
Hot Water Valve				X
Hot Water Circulator Start/Stop			X	
Hot Water Circulator Status	X			
Discharge Air Temperature		X		
Outside Air Damper				X
Bypass Damper				X
Hot water Coil Discharge Temperature		X		
Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature	.1	X	L	<u> </u>

Point Description		Binary Input	Analog Input	Binary Output	Analog Output
Condensing Unit Start/Stop	(Typ. of 2)			X	
Condensing Unit Status	(Typ. of 2)	X			
Chilled Water Pump Start/Stop				X	
Chilled Water Pump Status		X			
Boiler					
Burner Start/Stop				X	
Burner Status		X			
Hot Water Return Temperature			X		
Hot Water Supply Temperature			X		
Hot Water Pump Start/Stop				X	
Hot Water Pump Status		X			
Standby Pump Start/Stop				X	
Standby Pump Status		X			
Radiant Heating Pump Start/Stop				X	
Radiant Heating Pump Status		X			

The system as described above will require an initial investment of approximately \$78,764 and result in an estimated savings of \$152,246 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.93 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 200 - Baseline 08-15-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	<-	Annual (\$)	Costs> (\$/sqft)*	
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	291599 28480 0 0 0	Therm	5739 17313 0 0 0	0.219 0.659 0.000 0.000 0.000 0.000	18.3 % 55.2 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			23052	0.878	73.5 %
Electric Natural Gas Fuel Oil Propane Remote Heating	0	kWh Therm	8300 0 0 0	0.316 0.000 0.000 0.000 0.000	25.1 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			8300	0.316	26.5 %
>>> GRAND TOTAL			31351	1.194	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 26256 sqft Conditioned floor area....: 21402 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 200 - PLC 08-15-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	<-	Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	233536 21115 0 0 0	kWh Therm 1000 lb	4596 12836 0 0 0	0.175 0.489 0.000 0.000 0.000 0.000	17.9 % 49.9 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			17432	0.664	67.7 %
Electric Natural Gas Fuel Oil Propane Remote Heating	0	kWh Therm	8300 0 0 0	0.316 0.000 0.000 0.000 0.000	32.3 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			8300	0.316	32.3 %
>>> GRAND TOTAL			25732	0.980	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 26256 sqft Conditioned floor area....: 21402 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 200 - DDC		01-	05-	95
Weather: Washington (Washington TMY)	H	AΡ	v3.	04
Prepared by: EINHORN YAFFEE PRESCOTT	Page	1	of	1
**********************	*****	+++		

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	<	Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	0	kWh Therm 1000 lb	4067 11192 0 0 0	0.155 0.426 0.000 0.000 0.000 0.000	17.3 % 47.5 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			15259	0.581	64.8 %
Electric Natural Gas Fuel Oil Propane Remote Heating	0	kWh Therm 1000 lb	8300 0 0 0	0.316 0.000 0.000 0.000 0.000	35.2 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			8300	0.316	35.2 %
>>> GRAND TOTAL	======		23559	0.897	100.0 %

Conditioned floor area..... 21402 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE ALTERNATIVE: BLDG200-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 200-BASE.LCC ALTERNATIVE LCC FILE: 200-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$1,115	-\$1,115
SUBTOTAL FUTURE COST ITEMS:	\$0	\$1,115	-\$1,115
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$72,096 \$331,719	\$72,096 \$316,810	\$0 \$14,909
SUBTOTAL	\$403,814	\$388,906	\$14,909
TOTAL P.V. LIFE-CYCLE COST	\$403,814	\$390,021	\$13,794

NET SAVINGS FROM ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE

Net Savings = P.V. of non-investment savings \$14,909 - Increased total investment \$1,115 Net Savings: \$13,794

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE

P.V. of non-investment savings
SIR = ----- = 13.37
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)

FOR ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 33.62%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 1 Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	· Life-Cycle		
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	727,922	727,922	0	0
Natural Gas	Therm	29,904	29,904	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
71				
Electricity:				
CO2 (Mg):	422.8	422.8	0.0	0.0
SOx (Kg):	3,552.7	3,552.7	0.0	0.0
NOx (Kg):	1,813.6	1,813.6	0.0	0.0
Natural Gas:				
CO2 (Mg):	157.9	157.9	0.0	0.0
SOx (Kg):	0.9	0.9	0.0	0.0
NOx (Kg):	119.6	119.6	0.0	0.0
Total:				
CO2 (Mg):	580.8	580.8	0.0	0.0
SOx (Kg):	3,553.6	3,553.6	0.0	0.0
NOx (Kg):	1,933.2	1,933.2	0.0	0.0

ENERGY MANAGEMENT SYSTEM (EMS) STUDY

FORT BELVOIR, VIRGINIA

1 NOVEMBER 1995

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE ALTERNATIVE: BLDG200-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 200-BASE.LCC ALTERNATIVE LCC FILE: 200-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-PLC	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$12,711	-\$12,711
SUBTOTAL FUTURE COST ITEMS:	\$0	\$12,711	-\$12,711
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$72,096 \$331,719	\$72,096 \$272,118	\$0 \$59,601
SUBTOTAL	\$403,814	\$344,214	\$59,601
TOTAL P.V. LIFE-CYCLE COST	\$403,814	\$356,925	\$46,890

NET SAVINGS FROM ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE

P.V. of non-investment savings
SIR = ----- = 4.69
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)

FOR ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 20.33%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 3 Discounted Payback occurs in year 3

ENERGY SAVINGS SUMMARY

Energy type	Units	Annu Base Case	al Consumption Alternative	Savings	Life-Cycle Savings
Electricity Natural Gas	kWh Therm	727,922 29,904	666,966	60,956	609,560
Natural Gas	Inerm	49,904	22,171	7,733	77,330

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	422.8	387.4	35.4	354.1
SOx (Kg):	3,552.7	3,255.2	297.5	1,856.4
NOx (Kg):	1,813.6	1,661.7	151.9	1,518.7
Natural Gas:				
CO2 (Mg):	157.9	117.1	40.8	408.4
SOx (Kg):	0.9	0.7	0.2	0.0
NOx (Kg):	119.6	88.7	30.9	309.3
Total:				
CO2 (Mg):	580.8	504.5	76.2	762.5
SOx (Kg):	3,553.6	3,255.8	297.7	1,856.4
NOx (Kg):	1,933.2	1,750.4	182.8	1,828.0

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE ALTERNATIVE: BLDG200-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 200-BASE.LCC ALTERNATIVE LCC FILE: 200-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

THE THE CONTROL OF TH	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$78,764	-\$78,764
SUBTOTAL FUTURE COST ITEMS:	\$0	\$78,764	-\$78,764
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$72,096 \$331,719	\$24,909 \$226,660	\$47,187 \$105,059
SUBTOTAL	\$403,814	\$251,569	\$152,246
TOTAL P.V. LIFE-CYCLE COST	\$403,814	\$330,333	\$73,482

NET SAVINGS FROM ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE

P.V. of non-investment savings
SIR = ----- = 1.93
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 10.12%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 5 Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	al Consumption	1	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	727,922	628,377	99,545	995,450
Natural Gas	Therm	29,904	18,411	11,493	114,930

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	422.8	365.0	57.8	578.2
SOx (Kg):	3,552.7	3,066.8	485.8	3,031.6
NOx (Kg):	1,813.6	1,565.6	248.0	2,480.1
Natural Gas:				
CO2 (Mg):	157.9	97.2	60.7	606.9
SOx (Kg):	0.9	0.6	0.3	0.0
NOx (Kg):	119.6	73.6	46.0	459.7
Total:				
CO2 (Mg):	580.8	462.2	118.5	1,185.2
SOx (Kg):	3,553.6	3,067.4	486.2	3,031.6
NOx (Kg):	1,933.2	1,639.2	294.0	2,939.8

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	1
Chilled Water Reset	0	1
Enthalpy Economizer	0	2
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	0	2
Maintenance Costs	0	2
Savings to Investment Ration (SIR)	10	5
Total	25	43

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed

that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicated that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC operation and maintenance this building should be considered for a DDC EMS installation as described above.

B. BUILDING 219 - FINANCE OFFICE BUILDING

Existing System Description

The mechanical system in this building consists of two air handling units, numerous fancoil units, two air cooled chillers, two pumps, two boilers, and several exhaust fans.

One air handling unit (AHU-1) which conditions the interior of the office areas of the building and provides ventilation air for the perimeter office areas is a central station type unit with a combination hot water/chilled water coil in a 2-pipe arrangement utilizing a two-way pneumatic control valve. Air handling unit (AHU-1A) serves the auditorium portion of the building and is a field built-up type unit with a supply fan, combination hot water/chilled water coil with a two-way control valve, and an electric resistance duct heater. This unit is equipped with an economizer control to utilize outside air for cooling during periods of mild weather and a humidity control to modulate the chilled water valve and electric duct heater to maintain the relative humidity level below 50%. The perimeter office portion of the building is served by 2-pipe fan coil units which are equipped with manual fan speed controls and thermostatically controlled electric two-way hot/chilled water valves.

One chiller (C-1) is a reciprocating type with two compressors and a two-circuit remote air cooled condenser. The other chiller (C-1A) is a packaged air cooled reciprocating type which is located outside of the building. This chiller serves the auditorium portion of the building. The compressors are cycled and staged to maintain a set chilled water supply temperature. Both chillers utilize refrigerant R-22.

Heating water for the building is provided by two parallel oil fired steam boilers through separate heat exchangers which serve both the auditorium and office portion of the building.

One steam condensate unit with a receiver and dual pumps provides the means for condensate return to the boilers. One chilled water/hot water pumps serve each of the two portions of the building circulating chilled water for summer cooling and hot water for winter heating.

Analysis of EMS options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 60 Ton Air Cooled Chiller

2 Compressors @ 55 Amps, 460 Volt, 3 Phase

 $2 \times 55 \times 460 \times \sqrt{3}$

= 87642 VA

2 Fan Motors @ 11.0 Amps, 460 Volt, 3 Phase $2 \times 11.0 \times 460 \times \sqrt{3}$

= 17528 VA

1 - 40 Ton Air Cooled Chiller

2 Compressors @ 40 Amps, 460 Volt, 3 Phase

 $2 \times 40 \times 460 \times \sqrt{3}$

= 63739 VA

4 Fan Motors @ 1.8 Amps, 460 Volt, 3 Phase

 $4 \times 1.8 \times 460 \times \sqrt{3}$

= 5737 VA

87642 VA + 17528 VA + 63739 VA + 5737 VA

= 174646 VA

174646 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts

= 113.5 kW

113.5 kW x \$12.54/kW demand charge/month

- = \$1423/month x 12 months/year
- = \$17076/year / 10 buildings
- $= \frac{\$1708}{\text{vear}}$

This demand savings estimate applies to both the FMR (ECO #1) and DDC (ECO #3) systems for this building.

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1 to result in the savings as calculated above. The system would consist of one receiver/relay installed on each of two air cooled chillers (C-1 and C-1A) and one receiver/relay on the air cooled condenser (ACC-1) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately \$1,673 and result in an estimated savings of \$14,979 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 8.95 and a payback period of 1 year.

ECO #2 PLC: The PLC system selected for this building includes a PLC relay to control each air handling unit, pump and air cooled chiller as well as a relay for each electrical branch circuit feeding the fan coil units. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modern connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 219

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
AHU-1 A (Auditorium)			
Supply Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
AHU-1 B (Finance and Accounting)			
Supply Fan Start/Stop	X		
Return Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Fan Coil Units (Typ. of 38)			
Fan Start/Stop	X		
Boilers (Typ. of 2)			
Burner Enable/Disable			X
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Split Air Cooled Chiller			
Condenser Fans Enable/Disable		X	
Compressor Enable/Disable (Typ. of 2)		X	
Dual Temperature Water Pumps (Typ. of 2)			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately \$12,516 to install and will result in an estimated savings of \$91,836 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.34 and a payback period of 2 years.

ECO #3 DDC: This system includes a stand-alone controller for each air handling unit, air cooled chiller, and boiler as well as groups of 8 fan coil units. Each controller will be connected to a stand-alone building control panel through a communication bus. Each stand-alone controller will be capable of time of day scheduling, night setback and historic data logging while the building control panel is capable of providing demand limiting and optimum start for each piece of controlled equipment. In addition the controller for the boiler will be capable of resetting the hot water supply temperature based on the outside air temperature. The control panel will also allow for "dial-up access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a control points list for this system:

DDC POINTS LIST

Building - 219

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
AHU-1 (Finance and Accounting)				
Mixed Air Enthalpy		X		
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Return Fan Start/Stop			X	
Supply Fan Status	X			
Return Fan Status	X			
Dual Temperature Valve				X
Discharge Air Temperature		X		
Space Temperature		X		

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
AHU-1 A (Auditorium)				
Outside Air Enthalpy		X		
Return Air Enthalpy		X		
Mixed Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Supply Fan Status	X			
Dual Temperature Valve				X
Discharge Air Temperature		X		
Discharge Relative Humidity		X		
Reheat Step Control				X
Space Temperature		X		
Space Humidity		X		
Fan Coil Units (Typ. of 38)				
Fan Start/Stop			X	
Zone Temperature		X		
Boilers (Typ. of 2)				
Burner Start/Stop			X	
Burner Status	X			
Steam Discharge Pressure		X		
Condensate Return Temperature		X		
Hot Water Converter (Typ. of 2)				
Supply Steam Pressure		X		
Condensate Return Temperature		X		
Hot Water Return Temperature		X		
Hot Water Supply Temperature		X		
Steam Valve				X
Packaged Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Split Air Cooled Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Compressor Start/Stop			X	
Compressor Status	X			
Dual Temperature Water Loop (Typ. of 2)				
Dual Temperature Pump Start/Stop			X	
Dual Temperature Status	X			
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Changeover Valve			X	

The system as described above will require an initial investment of \$72,141 and result in an estimated savings of \$146,518 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 2.03 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 219 - Baseline 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		< Annual (\$)	Costs> (\$/sqft)*	% of Total	_
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	388008 23850 0 0 0	kWh Therm	7636 14499 0 0 0	0.232 0.440 0.000 0.000 0.000 0.000	23.9 % 45.5 % 0.0 % 0.0 % 0.0 %	8 8 8
>>> HVAC Subtotal			22135	0.672	69.4 %	5
Electric Natural Gas Fuel Oil Propane Remote Heating	496200 0 0 0 0	kWh Therm	9765 0 0 0 0	0.296 0.000 0.000 0.000 0.000	30.6 % 0.0 % 0.0 % 0.0 %	45
>>> Non-HVAC Subtotal			9765	0.296	30.6 %	5
>>> GRAND TOTAL	======		31900	0.969	100.0 %	= 5

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 32937 sqft
Conditioned floor area....: 32937 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 219 - PLC 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		< Annual (\$)	Costs> (\$/sqft)*	
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	190811 15490 0 0 0	kWh Therm	3755 9417 0 0 0	0.114 0.286 0.000 0.000 0.000 0.000	16.4 % 41.1 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			13172	0.400	57.4 %
Electric Natural Gas Fuel Oil Propane Remote Heating	496200 0 0 0 0	kWh Therm	9765 0 0 0	0.296 0.000 0.000 0.000 0.000	42.6 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			9765	0.296	42.6 %
>>> GRAND TOTAL			22937	0.696	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 32937 sqft Conditioned floor area....: 32937 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 219 - DDC 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy			Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	181447 15490 0 0 0	kWh Therm	3571 9417 0 0 0	0.108 0.286 0.000 0.000 0.000	15.7 % 41.4 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			12987	0.394	57.1 %
Electric Natural Gas Fuel Oil Propane Remote Heating	496200 0 0 0 0	kWh Therm	9765 0 0 0 0	0.296 0.000 0.000 0.000 0.000	42.9 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			9765	0.296	42.9 %
>>> GRAND TOTAL	======	=====	22753	0.691	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 32937 sqft
Conditioned floor area...: 32937 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE ALTERNATIVE: BLDG219-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 219-BASE.LCC ALTERNATIVE LCC FILE: 219-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

TNITTAL INVECTMENT ITEM/C).	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$1,673	-\$1,673
SUBTOTAL FUTURE COST ITEMS:	\$0	\$1,673	-\$1,673
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$51,685 \$331,859	\$51,685 \$316,880	\$0 \$1 4, 979
SUBTOTAL	\$383,544	\$368,565	\$14,979
TOTAL P.V. LIFE-CYCLE COST	\$383,544	\$370,238	\$13,306

NET SAVINGS FROM ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE

Net	Savings	P.V. of non- Increased to		3	s \$14, \$1,	-
			Net	Savings:	\$13,	306

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE

P.V. of non-investment savings
SIR = ----- = 8.95
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 28.37%

Simple Payback occurs in year 1 Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annu Base Case	al Consumption Alternative	n Savings	Life-Cycle Savings
Electricity	kWh	903,608	903,608	0	0
Natural Gas	Therm	25,043	25,043	0	0

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
mi a stari situr.				
Electricity:				
CO2 (Mg):	524.9	524.9	0.0	0.0
SOx (Kg):	4,410.1	4,410.1	0.0	0.0
NOx (Kg):	2,251.3	2,251.3	0.0	0.0
Natural Gas:				
CO2 (Mg):	132.3	132.3	0.0	0.0
SOx (Kg):	0.8	0.8	0.0	0.0
NOx (Kg):	100.2	100.2	0.0	0.0
Total:				
CO2 (Mg):	657.1	657.1	0.0	0.0
SOx (Kg):	4,410.9	4,410.9	0.0	0.0
NOx (Kg):	2,351.5	2,351.5	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE ALTERNATIVE: BLDG219-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 219-BASE.LCC ALTERNATIVE LCC FILE: 219-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-PLC	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$12,516	-\$12,516
SUBTOTAL FUTURE COST ITEMS:	\$0	\$12,516	-\$12,516
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$51,685 \$331,859	\$51,685 \$240,024	\$0 \$91,836
SUBTOTAL	\$383,544	\$291,709	\$91,836
TOTAL P.V. LIFE-CYCLE COST	\$383,544	\$304,225	\$79,320

NET SAVINGS FROM ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE

P.V. of non-investment savings
SIR = ----- = 7.34
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.84%

Simple Payback occurs in year 2 Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	al Consumptior	n	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity Natural Gas	kWh Therm	903,608	696,551 16,265	207,057	2,070,570 87,780

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	524.9	404.6	120.3	1,202.8
SOx (Kg):	4,410.1	3,399.5	1,010.6	6,305.8
NOx (Kg):	2,251.3	1,735.4	515.9	5,158.8
Natural Gas:				
CO2 (Mg):	132.3	85.9	46.4	463.6
SOx (Kg):	0.8	0.5	0.3	0.0
NOx (Kg):	100.2	65.1	35.1	351.1
Total:				
CO2 (Mg):	657.1	490.5	166.6	1,666.3
SOx (Kg):	4,410.9	3,400.0	1,010.8	6,305.8
NOx (Kg):	2,351.5	1,800.5	551.0	5,509.9

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE ALTERNATIVE: BLDG219-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 219-BASE.LCC
ALTERNATIVE LCC FILE: 219-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

TNICE TABLE COMPAND TOPM (C).	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$72,141	-\$72,141
SUBTOTAL FUTURE COST ITEMS:	\$0	\$72,141	-\$72,141
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$51,685 \$331,859	\$20,199 \$216,827	\$31,486 \$115,032
SUBTOTAL	\$383,544	\$237,026	\$146,518
TOTAL P.V. LIFE-CYCLE COST	\$383,544	\$309,167	\$74,377

NET SAVINGS FROM ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE

P.V. of non-investment savings
SIR = ----- = 2.03
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 10.67%

Simple Payback occurs in year 5 Discounted Payback occurs in year 5

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	al Consumption		Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	903,608	677,647	225,961	2,259,610
Natural Gas	Therm	25,043	15,490	9,553	95,530

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	524.9	393.6	131.3	1.312.6
SOx (Kg):	4,410.1	3,307.3	1,102.8	6,881.6
NOx (Kg):	2,251.3	1,688.3	563.0	5,629.7
Natural Gas:				, i
CO2 (Mg):	132.3	81.8	50.4	504.5
SOx (Kg):	0.8	0.5	0.3	0.0
NOx (Kg):	100.2	62.0	38.2	382.1
Total:				
CO2 (Mg):	657.1	475.4	181.7	1,817.1
SOx (Kg):	4,410.9	3,307.8	1,103.1	6,881.6
NOx (Kg):	2,351.5	1,750.3	601.2	6,011.9

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	1
Chilled Water Reset	0	1
Enthalpy Economizer	0	1
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	1	2
Savings to Investment Ration (SIR)	10	3
Total	27	40

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the

greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicated that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC system operation and maintenance this building should be considered for a DDC EMS installation as described above.

C. BUILDING 247 - HUMHPREY'S HALL

Existing System Description

The existing system consists of one chiller and an accompanying cooling tower, one large air handling unit and twenty small air handling units, numerous fan-coil units, two hot water boilers, nine pumps, and several exhaust fans.

The chiller is a water cooled centrifugal type which provides chilled water for the entire building and rejects its heat to an induced draft cooling tower which is located outside of the boiler room at grade level. The chiller utilizes refrigerant R-11 and should be considered for replacement or retrofit to address the CFC issue associated with this refrigerant.

The large air handling unit located in the penthouse mechanical room serves the auditorium which is located on the first and second floors of the building. This unit is a field built-up type unit with a combination hot water/chilled water coil which is piped in a two-pipe arrangement with a three-way pneumatic control valve. The unit is equipped with a pneumatically operated outside air damper which can be adjusted manually by use of a pneumatic pressure regulator to set the outside air percentage. The small air handling units are single zone, constant volume, central station type with separate hot water and chilled water coils which are piped in a 2-pipe arrangement, each having a separate electric three-way control valve and two-way isolation valve. These units are equipped with self contained direct digital controls which provide comfort control as well as time of day scheduling functions. These units serve the classroom and administrative office areas which are located in the various wings of the building.

The faculty offices and administrative support areas are served by console type fan coil units which are located on the perimeter walls and are piped in a 2-pipe arrangement. Each unit is equipped with a manual fan speed control and a thermostatically controlled two-way electric control valve. The areas served by these units have no apparent means of outside air for the occupants. This is a potential source of indoor air quality problems in this building.

Hot water for heating the building is generated by two hot water boilers which can utilize either oil or natural gas as a fuel source. According to Ft. Belvoir operating

personnel, these boilers also provide hot water for the adjacent buildings, 268, 269 and 270.

The hot water is circulated by four base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control.

The chilled water is circulated by two base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control

The condenser water is circulated by two base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control

Analysis of EMS Options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 300 Ton Water Cooled Chiller

1 Compressor 300 Tons @ 0.68 kW/ton 300 Ton x 0.68 kW/Ton

= 204 kW

204 kW x \$12.54/kW demand charge/month

- = \$2558/month x 12 months/year
- = \$30696/year / 10 buildings
- = \$3070/year

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the water cooled centrifugal chiller (C-1) to cycle the unit off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately \$558 and result in an estimated savings of \$26,923 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 48.29 and a payback period of 1 year.

ECO #2 PLC: The PLC system considered for this building includes a PLC relay for the chiller, cooling tower, and each boiler as well as one relay for each electrical branch circuit powering a fan coil unit. It is unknown at this time exactly how many branch circuits feed the fan coil units, so it was assumed for pricing purposes that on average, one branch circuit feeds 4 fan coil units. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modern connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 247

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Auditorium Air Handling Unit			
Supply Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Fan Coil Units (Typ. of 93)			
Fan Start/Stop	X		
Boilers (Typ. of 2)			
Burner Enable/Disable			X
Hot Water Pump Start/Stop			
Centrifugal Chiller			
Chiller Enable/Disable		X	
Chilled Water Pump Start/Stop (Typ. of 2)	X		
Condenser Water Pump Start/Stop (Typ. of 2)	X		
Cooling Tower Fan Start/Stop	X		

The system as described above will require an initial investment of approximately \$14,914 and result in an estimated savings of \$108,303 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.26 and a payback period of 2 years.

ECO #2 DDC: This system consists of one stand-alone controller for the chiller, and each boiler, and air handling unit as well as one for each 8 fan coil units. Each controller will be capable of providing time of day scheduling and night setback as well as hot water reset for the boilers and chilled water and condenser water reset for the chiller and cooling tower. A stand-alone building control panel will provide demand limiting, and optimum start control for each piece of equipment as well as serve as a communications point for all controllers in the system. The pumps for this building will be connected to the controller for the piece of equipment in which they serve. Example: The hot water heating pumps will be connected to the boiler controller while the chilled water pumps and condenser water pumps will be connected to the chiller controller. The building control panel will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a control points list for this system:

DDC POINTS LIST

Building - 247

			1	
Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Auditorium Air Handling Unit				
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Mixed Air Enthalpy		X		
Supply Fan Start/Stop		- 11	X	
Supply Fan Status	X		- 11	
DTW Control Valve				X
DTW Supply Temperature		X		
Outside Air Damper				X
Relief Damper				X
Return Damper				X
Discharge Air Temperature		X		
Fan Coil Units (Typ. of 93)				
Fan Start/Stop			X	
Zone Temperature		X		
Boilers (Typ. of 2)				
Burner Start/Stop	 		X	
Burner Status	X			
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Hot Water Pump Start/Stop			X	
Hot Water Pump Status	X		Λ_	
That water I ump Status	A .			
Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Chilled Water Pump Start/Stop (Typ. of 2)			X	
Chilled Water Pump Status (Typ. of 2)	X			
Condenser Water Supply Temperature		X		
Condenser Water Return Temperature		X		
Cooling Tower Fan Start/Stop			X	
Cooling Tower Fan Status	X			
Condenser Water Pump Start/Stop (Typ. of 2)		<u> </u>	X	

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Condenser Water Pump Status (Typ. of 2)	X			

The system as described above will require an initial investment of approximately \$87,416 and result in an estimated savings of \$166,883 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.91 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

FORT BELVOIR, VIRGINIA

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 247 - Baseline 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		< Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	592897 38163 0 0 0	kWh Therm	11668 23199 0 0 0	0.079 0.157 0.000 0.000 0.000	18.6 % 36.9 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal	· 		34868	0.235	55.5 %
Electric Natural Gas Fuel Oil Propane Remote Heating	1422880 0 0 0 0	kWh Therm	28002 0 0 0	0.189 0.000 0.000 0.000 0.000	44.5 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subto	tal		28002	0.189	44.5 %
>>> GRAND TOTAL		=====	62870	0.425	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 148067 sqft Conditioned floor area....: 143338 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 247 - PLC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		< Annual	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	406978 27010 0 0 0	kWh Therm	8009 16419 0 0 0	0.054 0.111 0.000 0.000 0.000 0.000	15.3 % 31.3 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			24429	0.165	46.6 %
Electric Natural Gas Fuel Oil Propane Remote Heating	1422880 0 0 0	kWh Therm	28002 0 0 0	0.189 0.000 0.000 0.000 0.000	53.4 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtot	28002	0.189	53.4 %		
>>> GRAND TOTAL 52431 0.354 100					100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 148067 sqft
Conditioned floor area....: 143338 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 247 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy			Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	404356 27079 0 0 0	kWh Therm	7958 16462 0 0 0	0.054 0.111 0.000 0.000 0.000 0.000	15.2 % 31.4 % 0.0 % 0.0 % 0.0 %
>>> HVAC Subtotal			24419	0.165	46.6 %
Electric Natural Gas Fuel Oil Propane Remote Heating	1422880 0 0 0 0	kWh Therm	28002 0 0 0	0.189 0.000 0.000 0.000 0.000	53.4 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal			28002	0.189	53.4 %
>>> GRAND TOTAL 52422					100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 148067 sqft Conditioned floor area...: 143338 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE ALTERNATIVE: BLDG247-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 247-BASE.LCC ALTERNATIVE LCC FILE: 247-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

THEORY THEORY THEN	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$558	-\$558
SUBTOTAL FUTURE COST ITEMS:	\$0	\$558	-\$558
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$125,733 \$639,123	\$125,733 \$612,199	\$0 \$26,923
SUBTOTAL	\$764,855	\$737,932	\$26,923
TOTAL P.V. LIFE-CYCLE COST	\$764,855	\$738,489	\$26,366

NET SAVINGS FROM ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings = P.V. of non-investment savings \$26,923 - Increased total investment \$558 Net Savings: \$26,366

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE

P.V. of non-investment savings
SIR = ----- = 48.29
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)

FOR ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 51.93%

Simple Payback occurs in year 1 Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy	Units	Anni	ual Consumption	n	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	2,045,422	2,045,422	0	0
Natural Gas	Therm	40,071	40,071	0	0

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	1,188.2	1,188.2	0.0	0.0
SOx (Kg):	9,982.8	9,982.8	0.0	0.0
NOx (Kg):	5,096.1	5,096.1	0.0	0.0
Natural Gas:				
CO2 (Mg):	211.6	211.6	0.0	0.0
SOx (Kg):	1.2	1.2	0.0	0.0
NOx (Kg):	160.3	160.3	0.0	0.0
Total:				
CO2 (Mg):	1,399.8	1,399.8	0.0	0.0
SOx (Kg):	9,984.0	9,984.0	0.0	0.0
NOx (Kg):	5,256.4	5,256.4	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE ALTERNATIVE: BLDG247-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis -- Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

3.1% Real (exclusive of general inflation) DISCOUNT RATE:

BASE CASE LCC FILE: 247-BASE.LCC ALTERNATIVE LCC FILE: 247-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-PLC	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$14,914	-\$14,914
SUBTOTAL FUTURE COST ITEMS:	\$0	\$14,914	-\$14,914
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$125,733 \$639,123	\$125,733 \$530,820	\$0 \$108,303
SUBTOTAL	\$764,855	\$656,553	\$108,303
TOTAL P.V. LIFE-CYCLE COST	\$764,855	\$671,467	\$93,389

NET SAVINGS FROM ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings = P.V. of non-investment savings \$108,303 Increased total investment \$14,914 Net Savings: \$93,389

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR) FOR ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE

> P.V. of non-investment savings ----- = 7.26 Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR) FOR ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE (Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.71%

Simple Payback occurs in year 2 Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	ual Consumption	n	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	2,045,422	1,850,207	195,215	1,952,150
Natural Gas	Therm	40,071	28,361	11,710	117,100

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	1,188.2	1,074.8	113.4	1,134.0
SOx (Kg):	9,982.8	9,030.0	952.8	5,945.2
NOx (Kg):	5,096.1	4,609.7	486.4	4,863.7
Natural Gas:	·			-,
CO2 (Mg):	211.6	149.8	61.8	618.4
SOx (Kg):	1.2	0.9	0.4	0.0
NOx (Kg):	160.3	113.4	46.8	468.4
Total:				
CO2 (Mg):	1,399.8	1,224.5	175.2	1,752.4
SOx (Kg):	9,984.0	9,030.9	953.1	5,945.2
NOx (Kg):	5,256.4	4,723.2	533.2	5,332.1
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Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE ALTERNATIVE: BLDG247-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

DISCOUNT RATE: 10.00 YEARS (JAN 1995 THROUGH DEC 2004 DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 247-BASE.LCC
ALTERNATIVE LCC FILE: 247-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-DDC	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$87,416	-\$87,416
SUBTOTAL FUTURE COST ITEMS:	\$0	\$87,416	-\$87,416
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$125,733 \$639,123	\$106,213 \$491,759	\$19,520 \$1 4 7,363
SUBTOTAL	\$764,855	\$597,972	\$166,883
TOTAL P.V. LIFE-CYCLE COST	\$764,855	\$685,388	\$79,467

NET SAVINGS FROM ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings = P.V. of non-investment savings \$166,883 - Increased total investment \$87,416 Net Savings: \$79,467

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE

P.V. of non-investment savings
SIR = ----- = 1.91
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 9.99%

Simple Payback occurs in year 5 Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy	Units	Annı	ual Consumption	n	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity	kWh	2,045,422	1,827,236	218,186	2,181,860
Natural Gas	Therm	40,071	27,079	12,992	129,920

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	1,188.2	1,061.4	126.7	1,267.4
SOx (Kg):	9,982.8	8,917.9	1,064.9	6,644.8
NOx (Kg):	5,096.1	4,552.5	543.6	5,436.0
Natural Gas:				
CO2 (Mg):	211.6	143.0	68.6	686.1
SOx (Kg):	1.2	0.8	0.4	0.0
NOx (Kg):	160.3	108.3	52.0	519.7
Total:				
CO2 (Mg):	1,399.8	1,204.4	195.4	1,953.5
SOx (Kg):	9,984.0	8,918.7	1,065.3	6,644.8
NOx (Kg):	5,256.4	4,660.8	595.6	5,955.7

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	0
Chilled Water Reset	0	1
Enthalpy Economizer	0	0
Time of Day Scheduling	10	10
Demand Limiting (Post Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	0	2
Savings to Investment Ratio (SIR)	10	3
Total	26	38

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the

greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicate that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC system operation and maintenance this building should be considered for a DDC EMS installation as described above.

D. BUILDING 1425 - GM SUPPORT BUILDING

Existing System Description

The existing building mechanical system consists of one chiller, one combination chilled water/hot water pump, numerous console fan-coil units, and several exhaust fans.

A packaged air cooled chiller provides chilled water for the entire building. This unit has self contained controls and cycles and stages its compressors to maintain a preset chilled water supply temperature. This chiller utilizes refrigerant R-22.

The entire building is served by a console type fan coil units which are equipped with combination hot/chilled water coils and are piped in a two-pipe arrangement. Each unit has a self contained control panel with a manual fan-speed control and a thermostatically controlled two-way electric control valve. Ventilation air is provided through a wall louver at each unit and is controlled by automatic damper. The building control system de-energizes the fan coil unit during the unoccupied periods of the day unless the setback is overridden manually or by the night thermostat which then switches control back to the individual fan coil unit.

Hot water for building heating is provided through a steam to hot water convertor which utilizes a remote steam source which is controlled by two pneumatically operated steam valves. The hot water supply temperature is adjusted in accordance with a hot water reset schedule which is based on the outside air temperature.

The two-pipe dual temperature piping system contains a change-over control valve which is used to change the system from cooling to heating and back again. This valve is controlled by a manual changer-over switch located in the face of the main automatic temperature control panel in the basement mechanical room. A high limit aquastat located in the dual temperature return piping prevents the change-over valve from switching to the cooling position when the water temperature is above 90 F and an additional high limit aquastat located in the chilled water return piping prevents the chiller from being energized when the chilled water return temperature is above 90 F.

Analysis of EMS Options

This building already contains an EMS which provides time of day scheduling, night setback and hot water reset. In order to provide a basis for comparison of similar buildings which are no equipped with an EMS the building was analyzed by assuming

that there was no EMS present and estimating a "No EMS" condition. This No EMS condition was then compared to proposed PLC and DDC systems to determine the applicability of such a system to buildings of similar construction and system type. This analysis resulted in the following systems:

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 40 Ton Air Cooled Chiller

3 Compressors @ 39.4 Amps, 200 Volt, 3 Phase $3 \times 39.4 \times 200 \times \sqrt{3}$

= 40946 VA

4 Fan Motors @ 4.1 Amps x 200 Volt, 3 Phase $4 \times 4.1 \times 200 \times \sqrt{3}$

= 5681 VA

40946 VA + 5681 VA

- = 46627 VA
- = 46627 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts
- = 30.3 kW

30.3 kW x \$12.54/kW demand charge/month

- = \$380/month x 12 months/year
- = \$4560/year / 10 buildings
- = \$456/year

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the air cooled chiller (C-1) to cycle the unit off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately \$558 and result in an estimated savings of \$3,999 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.17 and a payback period of 2 years.

ECO #2 PLC: The system would consist of one PLC relay for each electrical branch connection feeding a fan coil unit, it was assumed that this would result in approximately one relay for every 4 fan coil units. The air cooled chiller would also be connected to a relay. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modern connection. The transceiver would be capable of providing time of day scheduling for all connected

equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 1425

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Fan Coil Units (Typ. of 52)			
Fan Start/Stop			X
Outside Air Damper Open/Close		X	
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Dual Temperature Water Pumps (Typ. of 2)			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately \$11,518 and result in an estimated net savings of \$17,893 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.55 and a payback period of 6 years.

ECO #3 DDC: This system would consist of one stand-alone controller each for the air cooled chiller and hot water converter and one controller for each 8 fan coil units. The stand-alone controllers would provide time of day scheduling, night setback and historical data logging capabilities as well as hot water reset control for the converter. One stand-alone building control panel would provide the communications interface between each controller and demand limiting and optimum start capabilities. The building controller will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station The following is a control points list for this building:

DDC POINTS LIST

Building - 1425

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Fan Coil Units (Typ. of 52)				
Fan Start/Stop				X
Outside Air Damper				X
Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Hot Water Convertor				
Steam Supply Pressure		X		
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Steam Valve (Typ. of 2)				X
Dual Temperature Water Loop				
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Pump Start/Stop (Typ. of 2)			X	
DTW Pump Status (Typ. of 2)	X			
Changeover Valve (Typ. of 2)				X

The system as described above will require an initial investment of approximately \$48,993 and result in an estimated savings of \$33,374 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 0.68 and there is no payback.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 1425 - NO EMS 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<	Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	72273 0 0 0 0 242	kWh 1000	lb	1422 0 0 0 0 1934 0	0.092 0.000 0.000 0.000 0.125 0.000	20.1 % 0.0 % 0.0 % 0.0 % 27.3 % 0.0 %
>>> HVAC Subtotal				3356	0.218	47.3 %
Electric Natural Gas Fuel Oil Propane Remote Heating	189882 0 0 0 0	kWh 1000	lb	3737 0 0 0	0.242 0.000 0.000 0.000 0.000	52.7 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal	======			3737	0.242	52.7 %
>>> GRAND TOTAL	=====	=====		7093	0.460	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 15430 sqft Conditioned floor area...: 13736 sqft

FORT BELVOIR, VIRGINIA

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<		Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	56679 0 0 0 70	kWh 1000	lb	1115 0 0 0 0 560	0.072 0.000 0.000 0.000 0.036 0.000	20.6 % 0.0 % 0.0 % 0.0 % 10.3 % 0.0 %
>>> HVAC Subtotal				1675	0.109	31.0 %
Electric Natural Gas Fuel Oil Propane Remote Heating	189882 0 0 0 0		lb	3737 0 0 0 0	0.242 0.000 0.000 0.000 0.000	69.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal				3737	0.242	69.0 %
>>> GRAND TOTAL		=====	======	5412	0.351	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 15430 sqft Conditioned floor area....: 13736 sqft

FORT BELVOIR, VIRGINIA

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 1425 - DDC 01-05-95 Weather: Washington (Washington TMY)
Prepared by: EINHORN YAFFEE PRESCOTT HAP v3.04 Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<		Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	56679 0 0 0 70 0	kWh 1000	1b	1115 0 0 0 560	0.072 0.000 0.000 0.000 0.036 0.000	20.6 % 0.0 % 0.0 % 0.0 % 10.3 % 0.0 %
>>> HVAC Subtotal				1675	0.109	31.0 %
Electric Natural Gas Fuel Oil Propane Remote Heating	189882 0 0 0	kWh 1000	lb	3737 0 0 0 0	0.242 0.000 0.000 0.000 0.000	69.0 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal				3737	0.242	69.0 %
>>> GRAND TOTAL	=======			5412	0.351	100.0 %

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE ALTERNATIVE: BLDG1425-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 1425BASE.LCC ALTERNATIVE LCC FILE: 1425-FMS.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$558	-\$558
SUBTOTAL FUTURE COST ITEMS:	\$0	\$558	-\$558
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$41,840 \$71,752	\$41,840 \$67,753	\$0 \$3,999
SUBTOTAL	\$113,592	\$109,593	\$3,999
TOTAL P.V. LIFE-CYCLE COST	\$113,592	\$110,151	\$3,442

NET SAVINGS FROM ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE

Net Savings = P.V. of non-investment savings \$3,999
- Increased total investment \$558
------Net Savings: \$3,442

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE

P.V. of non-investment savings
SIR = ----- = 7.17
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.55%

Simple Payback occurs in year 2 Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy	Units	Anno	ual Consumptio	n	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Electricity Central Steam	kWh Pound	265,769 254,000	265,769 254,000	0	0

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				•
CO2 (Mg):	154.4	154.4	0.0	0.0
SOx (Kg):	1,297.1	1,297.1	0.0	0.0
NOx (Kg):	662.2	662.2	0.0	0.0
Central Steam:				
CO2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO2 (Mg):	154.4	154.4	0.0	0.0
SOx (Kg):	1,297.1	1,297.1	0.0	0.0
NOx (Kg):	662.2	662.2	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE ALTERNATIVE: BLDG1425-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 1425BASE.LCC ALTERNATIVE LCC FILE: 1425-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-PLC	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$11,518	-\$11,518
SUBTOTAL FUTURE COST ITEMS:	\$0	\$11,518	-\$11,518
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$41,840 \$71,752	\$41,840 \$53,859	\$0 \$17,893
SUBTOTAL	\$113,592	\$95,699	\$17,893
TOTAL P.V. LIFE-CYCLE COST	\$113,592	\$107,217	\$6,375

NET SAVINGS FROM ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE

P.V. of non-investment savings
SIR = ----- = 1.55
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 7.74%

ENERGY MANAGEMENT SYSTEM (EMS) STUDY FORT BELVOIR, VIRGINIA

1 NOVEMBER 1995

Simple Payback occurs in year 6 Discounted Payback occurs in year 7

ENERGY SAVINGS SUMMARY

Energy type	Units	Annu Base Case	ual Consumption Alternative	Savings	Life-Cycle Savings
Electricity Central Steam	kWh Pound	265,769 254,000	249,395 73.500	16,37 4 180,500	163,740 1,805,000
concrar becam	Louisa	234,000	75,500	100,300	1,005,000

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	154.4	144.9	9.5	95.1
SOx (Kg):	1,297.1	1,217.2	79.9	498.7
NOx (Kg):	662.2	621.4	40.8	408.0
Central Steam:				
CO2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO2 (Mg):	154.4	144.9	9.5	95.1
SOx (Kg):	1,297.1	1,217.2	79.9	498.7
NOx (Kg):	662.2	621.4	40.8	408.0

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE ALTERNATIVE: BLDG1425-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 1425BASE.LCC ALTERNATIVE LCC FILE: 1425-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$48,993	-\$48,993
SUBTOTAL FUTURE COST ITEMS:	\$0	\$48,993	-\$48,993
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$41,840 \$71,752	\$31,1 47 \$49,072	\$10,693 \$22,681
SUBTOTAL	\$113,592	\$80,218	\$33,374
TOTAL P.V. LIFE-CYCLE COST	\$113,592	\$129,211	-\$15,619

NET SAVINGS FROM ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE

P.V. of non-investment savings
SIR = ----- = 0.68
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = -0.78%

Simple Payback never reached during study period Discounted Payback never reached during study period

ENERGY SAVINGS SUMMARY

Energy type	Units	Annu Base Case	al Consumption Alternative	n Savings	Life-Cycle Savings
Electricity	kWh	265,769	246,561	19,208	192,080
Central Steam	Pound	254,000	70,000	184,000	1,840,000

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity.				
Electricity:				
CO2 (Mg):	154.4	143.2	11.2	111.6
SOx (Kg):	1,297.1	1,203.4	93.7	585.0
NOx (Kg):	662.2	614.3	47.9	478.6
Central Steam:				
CO2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO2 (Mg):	154.4	143.2	11.2	111.6
SOx (Kg):	1,297.1	1,203.4	93.7	585.0
NOx (Kg):	662.2	614.3	47.9	478.6

Recommendations

Please note that these recommendations for ECO implementation are not applicable to building 1425, only to buildings with similar systems which do not have an EMS.

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset		
Chilled Water Reset	0	1
Enthalpy Economizer		
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	1
Maintenance Scheduling	0	2
Optimum Start	1	1
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	11	2
Effect on Equipment Life	1	2
Maintenance Costs	1	1
Savings to Investment Ratio (SIR)	10	0
Total	27	32

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this

evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance. This system; however, does not provide a pay-back with-in the life of this study and does not qualify for funding under the current ECIP criteria.

The life cycle cost analyses indicated that the FMR and PLC systems meet the ECIP criteria.

The FMR system should be installed to cycle the chiller in accordance with the demand limiting strategy described in Example 2.1 of this study. The PLC system should be considered becuase it provides significant energy savings potential and qualifies for funding under the ECIP criteria. If there are any future renovations planned for this building that involve major mechanical system rework the DDC system will be the best alternative if installed at the time of renovation.

E. BUILDING 3136 - DAAF OPERATIONS BUILDING

Existing System Description

The existing building mechanical system consists of one chiller, one combination chilled water/hot water pump, numerous console fan-coil units, and several exhaust fans.

A packaged air cooled chiller provides chilled water for the entire building. This unit has self contained controls and cycles and stages its compressors to maintain a preset chilled water supply temperature. This chiller utilizes refrigerant R-22.

The entire building is served by a console type fan coil units which are equipped with combination hot/chilled water coils and are piped in a two-pipe arrangement. Each unit has a thermostat that cycles the fan on a call for heating or cooling. Ventilation air is provided through a wall louver at each unit and is controlled by a manual damper. These units are not equipped with control valve to regulate or stop the flow of water through the coils. During the heating season these units tend to act like radiators when ever there is hot water flowing in the building system. This can be a major source of discomfort and energy consumption because the rooms become overheated and as observed during our site visit the occupants are forced to open the windows to offset the "run away" heat. It was also noted during the site visit that the manual ventilation dampers in several of the fan coil units where completely closed or in-operable. Although it is beyond the scope of this study it should be noted that the age and poor condition of these fan coil units make them good candidates for replacement.

Hot water for building heating is provided through a steam to hot water convertor which utilizes a remote steam source which is controlled a pneumatically operated steam valve.

The two-pipe dual temperature piping system contains two change-over control valve which are used to change the system from cooling to heating and back again. This valve is controlled by a manual changer-over switch located on the wall of the basement mechanical room. There are no apparent safety controls on this change-over function

which would prevent hot water from being circulated through the packaged chiller, a situation which could cause damage to the chiller and possible discharge of refrigerant into the atmosphere.

Analysis of EMS Options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 40 Ton Air Cooled Chiller

3 Compressors @ 39.4 Amps, 200 Volt, 3 Phase $3 \times 39.4 \times 200 \times \sqrt{3}$

= 40946 VA

4 Fan Motors @ 4.1 Amps x 200 Volt, 3 Phase $4 \times 4.1 \times 200 \times \sqrt{3}$

= 5681 VA

40946 VA + 5681 VA

- = 46627 VA
- = 46627 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts
- = 30.3 kW

30.3 kW x \$12.54/kW demand charge/month

- = \$380/month x 12 months/year
- = \$4560/year / 10 buildings
- = <u>\$456/year</u>

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the air cooled chiller (C-1) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately \$558 and result in an estimated savings of \$3,999 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.17 and a payback period of 2 years.

ECO #2 PLC: The system would consist of one PLC relay for each electrical branch connection feeding a fan coil unit, it was assumed that this would result in approximately one relay for every 4 fan coil units. The air cooled chiller would also be connected to a relay. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modern connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 3136

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Fan Coil Units (Typ. of 47)			
Fan Start/Stop			X
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Dual Temperature Water Pumps			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately \$10,646 and result in an estimated savings of \$17,738 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ratio (SIR) of 1.68 and a payback period of 6 years.

ECO #3 DDC: This system would consist of one stand-alone controller each for the air cooled chiller and hot water converter and one controller for each 8 fan coil units. The stand-alone controllers would provide time of day scheduling, night setback and historical data logging capabilities as well as hot water reset control for the converter. One stand-alone building control panel would provide the communications interface between each controller and demand limiting and optimum start capabilities. The controller will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station The following is a control points list for this system:

DDC POINTS LIST

Building - 3136

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Fan Coil Units (Typ. of 47)				
Fan Start/Stop			X	
Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Hot Water Convertor				
Steam Supply Pressure		X		
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Steam Valve				X
Dual Temperature Water Loop				
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Pump Start/Stop			X	
DTW Pump Status	X			
Changeover Valve (Typ. of 2)			X	

The system as described above will require an initial investment of approximately \$48,614 and result in an estimated savings of \$32,715 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of .67 and there is no payback.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 3136 - Baseline 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<		Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	82975 0 0 0 413 0	kWh 1000	lb	1633 0 0 0 0 3292 0	0.139 0.000 0.000 0.000 0.280 0.000	16.4 % 0.0 % 0.0 % 0.0 % 33.0 % 0.0 %
>>> HVAC Subtotal				4925	0.419	49.4 %
Electric Natural Gas Fuel Oil Propane Remote Heating	256487 0 0 0 0	kWh 1000	lb	5048 0 0 0	0.429 0.000 0.000 0.000 0.000	50.6 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal				5048	0.429	50.6 %
>>> GRAND TOTAL	======	=====		9973	0.848	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area.....: 11760 sqft Conditioned floor area....: 10600 sqft

FORT BELVOIR, VIRGINIA

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 3136 - PLC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<	Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	75724 0 0 0 0 228 0	kWh	1b	1490 0 0 0 1818	0.127 0.000 0.000 0.000 0.155 0.000	17.8 % 0.0 % 0.0 % 0.0 % 21.8 % 0.0 %
>>> HVAC Subtotal				3308	0.281	39.6 %
Electric Natural Gas Fuel Oil Propane Remote Heating	256487 0 0 0 0	kWh 1000	1b	5048 0 0 0	0.429 0.000 0.000 0.000 0.000	60.4 % 0.0 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal 5048 0.429 60.4 %						
>>> GRAND TOTAL				8356	0.711	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 11760 sqft Conditioned floor area...: 10600 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 3136 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy		<	Annual (\$)	Costs> (\$/sqft)*	% of Total
Electric Natural Gas Fuel Oil Propane Remote Heating Remote Cooling	75724 0 0 0 0 228 0	kWh 1000	1b	1490 0 0 0 1818 0	0.127 0.000 0.000 0.000 0.155 0.000	17.8 % 0.0 % 0.0 % 0.0 % 21.8 % 0.0 %
>>> HVAC Subtotal				3308	0.281	39.6 %
Electric Natural Gas Fuel Oil Propane Remote Heating	256487 0 0 0 0		lb	5048 0 0 0 0	0.429 0.000 0.000 0.000 0.000	60.4 % 0.0 % 0.0 % 0.0 %
>>> Non-HVAC Subtotal				5048	0.429	60.4 %
>>> GRAND TOTAL	======	=====	======	8356 8356	0.711	100.0 %

^{*} Cost per unit floor area is based on the gross building floor area.

Gross floor area....: 11760 sqft Conditioned floor area...: 10600 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE ALTERNATIVE: BLDG3136-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 3136BASE.LCC ALTERNATIVE LCC FILE: 3136-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

INITIAL INVESTMENT ITEM(S):	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-FMR	SAVINGS FROM ALT.
CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$558	-\$558
SUBTOTAL FUTURE COST ITEMS:	\$0	\$558	-\$558
ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$19,902 \$100,793	\$19,902 \$96,79 4	\$0 \$3,999
SUBTOTAL	\$120,694	\$116,695	\$3,999
TOTAL P.V. LIFE-CYCLE COST	\$120,694	\$117,253	\$3,442

NET SAVINGS FROM ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings = P.V. of non-investment savings \$3,999 - Increased total investment \$558 Net Savings: \$3,442

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE

P.V. of non-investment savings
SIR = ----- = 7.17
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.55%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 2 Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy	Units	Annu	al Consumption	1	Life-Cycle
type		Base Case	Alternative	Savings	Savings
Floatwieite	1-1-1-	246 101	246 101		
Electricity	kWh	346,101	346,101	Ü	0
Central Steam	Pound	433,650	433,650	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:			~	
CO2 (Mg):	201.0	201.0	0.0	0.0
SOx (Kg):	1,689.2	1,689.2	0.0	0.0
NOx (Kg):	862.3	862.3	0.0	0.0
Central Steam:				
CO2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO2 (Mg):	201.0	201.0	0.0	0.0
SOx (Kg):	1,689.2	1,689.2	0.0	0.0
NOx (Kg):	862.3	862.3	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE ALTERNATIVE: BLDG3136-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004) DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 3136BASE.LCC ALTERNATIVE LCC FILE: 3136-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

THIRTAL TARVECOMENO	IMPM/C).	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT CASH REQUIREMENTS		TE \$0	\$10,646	-\$10,646
SUBTOTAL		\$0	\$10,646	-\$10,646

ENERGY MANAGEMENT SYSTEM (EMS) STUDY

CORT BELVOID VIDCINIA

FORT BELVOIR, VIRGINIA		11	NOVEMBER 1995
FUTURE COST ITEMS: ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$19,902 \$100,793	\$19,902 \$82,855	\$0 \$17,938
SUBTOTAL	\$120,694	\$102,757	\$17,938
TOTAL P.V. LIFE-CYCLE COST	\$120,694	\$113,403	\$7,292

NET SAVINGS FROM ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings = P.V. of non-investment savings \$17,938 - Increased total investment \$10,646 Net Savings: \$7,292

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE

P.V. of non-investment savings
SIR = ----- = 1.68
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 8.62%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 6 Discounted Payback occurs in year 7

ENERGY SAVINGS SUMMARY

Energy type	Units	Base Case	ual Consumptio Alternative	n Savings	Life-Cycle Savings
Electricity	kWh	346,101	335,997	10,104	101,040
Central Steam	Pound	433,650	239,400	194,250	1,942,500

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	201.0	195.2	5.9	58.7
SOx (Kg):	1,689.2	1,639.8	49.3	307.7
NOx (Kg):	862.3	837.1	25.2	251.7
Central Steam:				
CO2 (Kg):	0.0	0.0	0.0	0.0

1 NOVERTHER 1005

ENERGY MANAGEMENT SYSTEM (EMS) STUDY

F	ORT BELVOIR, V	IRGINIA			1 NOVEMBER 1995	
SOx (Kg):	0.0	0.0	0.0	0.0	
NOx (Kg):	0.0	0.0	0.0	0.0	
Total:						
CO2 (Mg):	201.0	195.2	5.9	58.7	
SOx ((Kg):	1,689.2	1,639.8	49.3	307.7	
NOx ((Kg):	862.3	837.1	25.2	251.7	

1 NOVEMBER 1995

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE ALTERNATIVE: BLDG3136-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)

DISCOUNT RATE: 3.1% Real (exclusive of general inflation)

BASE CASE LCC FILE: 3136BASE.LCC ALTERNATIVE LCC FILE: 3136-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S): CASH REQUIREMENTS AS OF SERVICE DATE	\$0	\$48,614	-\$48,614
SUBTOTAL	\$0	\$48,614	 -\$48,614
FUTURE COST ITEMS: ANNUAL AND NON-AN. RECURRING COSTS ENERGY-RELATED COSTS	\$19,902 \$100,793	\$10,736 \$77,243	\$9,166 \$23,550
SUBTOTAL	\$120,694	\$87,979	\$32,715
TOTAL P.V. LIFE-CYCLE COST	\$120,694	\$136,593	-\$15,899

NET SAVINGS FROM ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings = P.V. of non-investment savings \$32,715 - Increased total investment \$48,614 Net Savings: -\$15,899

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE

P.V. of non-investment savings
SIR = ----- = 0.67
Increased total investment

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = -0.90%

ESTIMATED YEARS TO PAYBACK

1 NOVEMBER 1995

Simple Payback never reached during study period Discounted Payback never reached during study period

ENERGY SAVINGS SUMMARY

Energy	Units	Anni	ual Consumption	n	Life-Cycle
type	j	Base Case	Alternative	Savings	Savings
Electricity	kWh	346,101	332,211	13,890	138,900
Central Steam	Pound	433,650	228,000	205,650	2,056,500

EMISSIONS REDUCTION SUMMARY

Annual Base Case	Emissions Alternative	Annual Reduction	Life-Cycle Reduction
201.0	193.0	8.1	80.7
1,689.2	1,621.4	67.8	423.0
862.3	827.7	34.6	346.1
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
201.0	193.0	8.1	80.7
1,689.2	1,621.4	67.8	423.0
862.3	827.7	34.6	346.1
	201.0 1,689.2 862.3 0.0 0.0 0.0 201.0 1,689.2	201.0 193.0 1,689.2 1,621.4 862.3 827.7 0.0 0.0 0.0 0.0 0.0 0.0 201.0 193.0 1,689.2 1,621.4	Base Case Alternative Reduction 201.0 193.0 8.1 1,689.2 1,621.4 67.8 862.3 827.7 34.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 201.0 193.0 8.1 1,689.2 1,621.4 67.8

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC.	DDC
Hot Water Reset	0	1
Supply Air Reset		
Chilled Water Reset	0	1
Enthalpy Economizer		
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	1
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	2	2
Maintenance Scheduling	0	2
Optimum Start	1	1
Occupant Control/Override	1	1
Comfort Control	0	. 2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	1	1
Savings to Investment Ratio (SIR)	10	0
Total	28	32

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance. This

system; however, does not provide a pay-back with-in the life of this study and does not qualify for funding under the current ECIP criteria.

The life cycle cost analyses indicated that the FMR and PLC systems meet the ECIP criteria.

The age and condition of the fan coil units and the control system in this building make it a candidate for a mechanical system replacement. An example is that the fan coil units are not equipped with control valves to stop the flow of water through coil when cooling or heating is not needed. This situation causes the fan coil units to act as radiators during the heating season even after the thermostat has been satisfied and has cycled the fan off. The installation of total system EMS at the time of new equipment installation would be more cost effective.

The building is served by a packaged air cooled chiller which can be cycled to provide electrical demand savings. This building should be equipped with and FMR relay and entered into a demand limiting schedule in accordance with the strategy outlined in Example 2.1 of this report.

APPENDICES

APPENDIX A FIELD SURVEY DATA SHEETS

BUILDING 200

Air Cooled Condensing Unit Survey Data Sheet

Project Name: 17 BELVOIR EMS STUBY Project Number: 60692 0
Building: 200
Unit No. ACU Location BING BIO'S Area Served MICE C-1
Compressors: Reciprocating Number Horespower FLA 2!
Fans: Number 6 RPM 1075 Horsepower 1.5
Electrical: Volts 100 FLA Phase 3 Hertz 60
Manufacturer 40006EA - 710E 621-0181-14
Controls: Settle * 36-13374 None X Motor Starter HOA Switch D. S,
Remarks: Conflessows All EQUATED OF UNLOADERS CHICH WERE DISCONNECTED AT TIME OF SHEVEY.

Control of the second of the s

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STO Project Number: 66692.00	04
Building: 200	
Acres 2 Acres A rad	area Served AHILLER (-1
	area Serveu
Compressors: Reciprocating	Number
Rotary	Horespower
Fans:	FLA 21/ 1/4 791
Number 4 RPM 1075	Horsepower <u>15</u>
Electrical: Volts 200	,
FLA	Phase $\frac{3}{40}$ Hertz $\frac{3}{40}$
Manufacturer TRANE Model RAVA - 6006 - EA 7418 6	CI - 0181 - 1A
Sexual 36-13373 Controls:	Of Otol IA
None X HOA Switch	rter
Remarks:	

Aiding: 200 Unit No. 2001 Location	Project Name: 17 EDIOR EMS STUDY Project Number: 60692.00	
Air Type: Constant Volume Zone Type: Single Zone Multi-Zone Chilled Water None Heating: Hot Water Electric Supply Fan: Forward Curved Backward Incline Airfoil Notes Super Hoa Switch Airfoil Airfoil Airfoil Motor Starter HoA Switch Airfoil Airf		
Constant Volume	Unit No. AHD- Location REAR MECH. ROOM	Area Served
Single Zone Multi-Zone Cooling:	Air Type: Constant Volume	Variable Volume
Chilled Water None DX	Zone Type: Single Zone	Multi-Zone
Steam	Chilled Water N	DX
Forward Curved Backward Incline Variable Frequency Drive Motor Starter HOA Switch Variable Frequency Drive Motor Starter 1/ P.E. LEBRY Infiguration:	Hot Water $\sqrt{}$	
Blow-Thru Draw-Thru Draw-Thru Motor Horespower Phase Hertz Horespower Phase Hertz Manufacturer Manufacturer Model Model None Fan No. Latt Fan No. None Outdoor Enthalpy Drybulb Comparison Outdoor Drybulb Enthalpy Comparison Outdoor Drybulb Enthalpy Comparison	Forward Curved Backward Incline	Inlet Vanes Variable Frequency Drive
Horespower	Blow-Thru	
Return Air Fan: Fan No. None Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	HorespowerPhase Hertz	——————————————————————————————————————
Return Air Fan: Fan No. None Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Manufacturer TEANB CUMPUS CHANGE	GER 12/247369
None Outdoor Drybulb Enthalpy Comparison	7010.	
Remarks: 3 way Pribumatu VALVES CHILLED of HOT WATER	None Outdoor Enthalpy 1	
	Remarks: 3 way PNEUMATIC VALVE	5 CHILLED of HOT WATER

A-4

Project Name: The VOIR PMS S Project Number: 4069200	-TAT
Building: 200	
Unit No. RAT Location REAR MECH. ROOM	Area Served AHU-
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase Hertz	Volts 200 Amps RPM
Manufacturer	
Controls: None Motor S Inlet Vanes Variable HOA Switch	Starter X Whe leavy
Remarks:	MOTOR NAMEPLATE
TO TO THE NO.	(POLOTON NOTE OF CALE

Project Name: 17 hand EMS STUDY Project Number: 60692.60	
ailding: Zoo	
Unit No. AHU 2 Location ME 22AVILLE	Area Served
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX
Heating: Hot Water Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter HOA Switch
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower 10 Phase 2 Hertz 1746 Cerr	Volts 100 Amps 34,4 MoA & 05
Manufacturer TANE CUMATE CHANGE Model 7466 LZ-ZI SEUM	K3J247372
Return Air Fan: Fan No. <u>RAF-2</u>	None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison 7	Outdoor Drybulb Enthalpy Comparison
Remarks: 3 - Zanes Riverin	ATIC ACTUATORS TOL ZOUT DANGER.
3-way Varios on	CHILLEN of HOT WATER
PNOWATIL RETURN	RELIEF & OA SAMPERS

A-6

Project Name: 1601920 EMS 57	yu *
Building: 200	
Unit No. RF LLocation MECCANINE	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved
Motor: Horespower Phase 3 Hertz Co	Volts Zoo Amps RPM
ManufacturerTLANE Model	
Controls: None Motor Inlet Vanes Variat HOA Switch	Starter Dle Frequency Drive
Remarks: DS & MOTOR S	TARTER & P.E. RELAY
100 / 300 / 300 M	MARTER SQUALED 11,5 HEATERS
COULD NOT REACH	MOTOR NAMEPLATE

Project Name: FT POLYOR EMS STUDY Project Number: 60692.00	
uilding: 200	
Unit No. Ato S Location MEZZANINE	Area Served
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX
Heating: Hot Water	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter HOA Switch
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower Phase Hertz Hertz	Volts 200-208 Amps 10.6 1760-8M
Manufacturer TRANETE CLIMATE	CHANGER
Return Air Fan: Fan No. Fan No.	SERIAL K3 3 47370 None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison \(\textstyle \)	Outdoor Drybulb Enthalpy Comparison
Remarks:	
13 WAY VAUES C	HILLED WATER & HOT WATER
PNBVMK(IC	
PNEUMATIC RETURN, RELIEF	4 DA DAMPER AC

A-8

Project Name: FI PEUOLEMS STUDY Project Number: 60092.00		
Building: Zoo		
Unit No. RAT 3 Location	Area Served AHU - 3	
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline	
Motor: Horespower Phase Hertz	Volts 200 Amps RPM	
Manufacturer WANS Model U-24-81		
	Starter	
Remarks: Motor	STANION W/ P. T. Corry	
COULD NOT REACH MOTOR NAMBPLATE		

oject Name: FI BELIDIR EMS STUDY oject Number: 60692 - 00	
nilding: 200	
nit No. AHV. Hocation MECEBONNE	Area Served
r Type:	
Constant Volume	Variable Volume
one Type: Single Zone	Multi-Zone X
Chilled Water X None	DX
eating: Hot Water Electric	Steam None
pply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter HOA Switch
onfiguration: Blow-Thru Draw-Thru	Horizontal X Vertical
Horespower Phase Hertz	Volts 200 Amps 16.6 176 Am
anufacturer — GRANE CLIM odel — M 7-14	ACE CHANGEL
eturn Air Fan: Fan No. RAF-4	None
onomizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb Enthalpy Comparison
emarks: 7 Jones N	PNOVMATIL ZONE DAMPOL RECURTORS
PHOVERT	16 3-WAY HAWB CHILLED WATER \$140

A-10

Project Name: F1 BEWOR 6 Project Number: 60697, 30	MS SWY
Building: 200	
Unit No. RAFF Location	Area Served #HU-4
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase 3 Hertz 60	Volts Zoo Amps RPM
Manufacturer TRANE Model	271-61
	Motor Starter N W HOA & PB. Rowey Variable Frequency Drive
Remarks: Covid N	LOT REACH MUTOR NAMEPLATE

Project Name: H BOLVOR ENS STUDY Project Number: 6001200	,
Unit No. AHU: 5 Location MEZBANINE	Area Served
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX
Heating: Hot Water Electric	Steam
Supply Fan: Forward Curved Backward Incline Airfoil	None Controls: Inlet Vanes Variable Frequency Drive
nfiguration: Blow-Thru	Motor Starter HOA Switch Horizontal
Motor Horespower Phase	Vertical
Manufacturer THANK (LW Model	MATE CHUNEOR
Return Air Fan: Fan No. RN -5	None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison 7	Outdoor Drybulb Enthalpy Comparison
Remarks: 3 Marragic 3-W	MY VALUES CHILLED & HOT GLATER

A-12

Project Name: TO BEVOR TMS ST Project Number: 40692 3	DDY
Building: 200	
DAVE WALLS	Area Served AHV-5
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved
Motor: Horespower Phase Hertz	Volts Amps RPM
Manufacturer TRANE Model 1) - 77 - 8	
Controls: Syruat K	Starter A W RE LEAM e Frequency Drive
Remarks: Could Not R	EACH MOTOR NAMEPLATE

Project Name: FT BEZ VOIR EMS STUDY Project Number: 60692.00	
illding: 200	
Unit No. AHVU Location REAR MECH NEXT	Area Served
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX
Heating: Hot Water X Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower Phase Hertz	Volts 200 Amps
Manufacturer	CHANGER
Return Air Fan: Fan No	None X
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb Enthalpy Comparison
Remarks: WO'S DUTHING AIR	
3	

A-14

Project Name: 16 DECVO/R Project Number: 1006 92, 30	
Building: 200	
Unit No. Location	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor:	
Horespower Phase Hertz	Volts Amps RPM
Manufacturer	
Controls:	
None Inlet Vanes HOA Switch	Motor Starter Variable Frequency Drive
Remarks:	

Project Name: F7 DELVOIR EMS: Project Number: WAZ.00	<u>57004</u>	
Building: Zoo		
Unit No. Ef & Location	Area Served	.,
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil	
Motor: Horespower Phase Hertz	Volts Amps RPM	
Manufacturer		
Controls:		
None Inlet Vanes HOA Switch	Motor Starter Variable Frequency Drive	·
Remarks:		
		-

Project Name: 19 DECI/DIK EM Project Number: 100 692	15 5004
Building:	
Unit No. EF Location MEZZANNE	Area Served
Fan Type:	~
Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor:	
Horespower	Volts
Phase	Amps
Hertz	RPM
Manufacturer	
Model U- 963	- FC
903	7
Controls:	
None Motor	Starter
Inlet Vanes Varia	ble Frequency Drive
HOA Switch	
Remarks:	
COULD ALOT ROM	H MOTOR NAME PLATE
COOL MAIL LIBRO	AT THIS WAY THE TOTAL
CUTLER LAMMER	SUAP SWITCH WINDULTOR LIGHT
	The control of the control

Project Name: 1000/00 EMG 67	
Building: 700	
Unit No. POI-1 Location	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase Hertz	Volts Amps RPM
ManufacturerModel	
Controls:	
None	Motor Starter Variable Frequency Drive
Remarks:	

Fan Data Sheet

Project Name: HOUVOIR EMS STAX Project Number: 60692.00	<u>?Y</u>
Building: 260	
Unit No. 16V-Z Location KOOF	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor:	
Horespower	Volts
Phase Hertz	Amps RPM
Manufacturer	
Controls:	
None	Motor Starter
Inlet Vanes	Variable Frequency Drive
HOA Switch	
Remarks:	

Project Name: TOUVOIR EN Project Number: WX 96,00	15 Sway	
Building: <u>200</u>		
Unit No. AM Location ENTRY VEST	Area Serve	ed ENTRY VESTIBILE
Cooling: Chilled Water None \(\sum_{\text{N}} \)		
Heating: Hot Water Steam Electric KW None		
Fan Motor Horespower Phase Hertz	Volts Amps RPM	No.
Electrical: Volts Hertz Manufacturer TEANE	Phase FLA	
Model Controls: Self Contained Outside Air	Remote A	T-STAT FAN SAEED SWITCH
Remarks:		

Project Name: 17 DE Project Number: 1000 Project Nu	EVOIR B	MS STUDY		
Building:				•
Unit No. CVH- 2 Location	ENTRY	VESTIBULE	Area Serve	ENTRY VESTIBULE
Cooling: Chilled Water				
Heating: Hot Water Steam Electric None	_ KW			
Fan Motor Horespower Phase Hertz		Volts Amps _ RPM		
Electrical: Volts Hertz		Phase _ FLA	<u> </u>	
Manufacturer TRANE Model				
Controls: Self Contained Outside Air		Remote	X	TISTAT # FAN SEED SWITCH
Remarks:				

Project Name: The York EMS STUDY Project Number: BUST. C.
Building:
Unit No. 16-1 Location REAL METH ROOM Area Served ENTILE BURG
Motor:
Horespower Volts Phase Amps Hertz RPM
Phase Amps RPM Manufacturer AW/O SPENCE DIVISION Model HF 311 O/W ATELL H-311 Controls:
Controls: Social + 4344 7484 4-311 None Variable Frequency Drive
Motor Starter HOA Switch
HORGING SUEFACE 289 SYFT GROSS OUTRY 1339
WET RATING 1165
40 HP
EIL 12 GPH
GKS Z MBH
BURNOL MODEL 58-0-05
7.06PH MIN
12,. 6PM MAX
BURNEL 208 37 1.9 AND
On only

Project Name: H BEZVOIR EMS STUDY
Project Number: 60077,00
Building: 200
Unit No. 1 Location hear MECH from Area Served CHILLEY WATER
Motor: Horespower 7.5 Volts 200-2019
Horespower 1/5 Volts 200- 2019 Phase 3 Amps 23
Hertz Go
Show A Comme
Manufacturer DUC & G0558 [
Model 485 - 8 - 18 BF
Controls:
None Variable Frequency Drive
None Variable Frequency Drive Motor Starter HOA Switch
Remarks:
BASE MOUNTED END SUCTION
E LE L'ESTATEL O DIC LICH

Project Name: FY BEVOR BUS SUNT Project Number: 506 97, 50
Building: 200
Unit No. P. Z Location REAR MECH, Run Area Served HOT WATER Runs
Motor: Horespower 3 Phase 4 Hertz 4 RPM 1725
Manufacturer BEU & GOSSET Model BEU & GOSSET SEXIES 15/0
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: BASE MOUNTED END. SULTION

Project Name: FT BEZVOIR EMS S-CUOT Project Number: 40692, as
Building: 200
Unit No. P. S. Location REAR MECH ROOM Area Served STANDBY Rune
Motor: Horespower 3 Phase 3 Hertz 6 Horespower 1 Nolts 20 Amps 70.8 RPM 745
ManufacturerModel
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: BASE MOUNTED END SUZTION

Project Name: FT BEWOR GMS SWAY Project Number: 60692.00
Building: Zoo
Unit No. Ly Location REAR MEHR Area Served AHU-6
Motor: Horespower Volts Phase Amps
Hertz RPM Manufacturer BEU + GOSSETT
Model
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: WILLOR HAMMER SWAP SWITCH & INDICATOR LIGHT
IN LINE CONTRIFUGAL

Project Name: 17 17 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18
Building:
Unit No. P.5 Location REAR MEHRM Area Served FINNED TUBE
Motor: Horespower Volts Phase Amps
Hertz RPM RPM Manufacturer BELL & GOSSET Model
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: (RE. LORAY CONTROUGH SWITCH LY INDICATOR LIGHT INLINE LENTENBER TOTAL SWITCH LY INDICATOR LIGHT
The live in y Walle

BUILDING 219

Boli ER

Project Name: FT DEZUAR EMS Project Number: 60697, ov
Building: 219A
Unit No. B- Location BASEMENT MECHEM Area Served ENTIRE BLDG
Motor:
Horespower Volts Phase Amps Hertz RPM
Manufacturer WEIL MCLEAN Model BOLLER MODEL COULD NOT BE READ
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: PEABOOY GORDON PLATT BURNER OIL FIRM
19 GAT RLS 8,2-0-10
CAST IRON OLD
15751 RELIEF VALVE

HN RESET 55 90° 27/2 135 0° 180

BOILER Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00
Building: 219
Unit No. B-2 Location AUDITORIUM BASEMONTArea Served ENTIRE BLDG
Motor:
Horespower Volts
Phase Amps
Hertz RPM
Manufacturer WEIL Mc LAIN
Model NO NAME PLATE FOUND
Controls:
None Variable Frequency Drive Motor Starter HOA Switch
Note: State:
Remarks: CAST IRON BOILER
PEABOOT GORDON PLATT OIL BURNOR
19 CP-1
1 STA

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00
Building: 219
Unit No. C-1 Location South MECH Room Area Served BLD6 Z19
Compressors: Reciprocating Number 2 Centrifugal Horespower Rotary
Condenser Type: Air Cooled Packaged Air Cooled Remote (Condenser
Electrical: Volts 460 FLA Phase 3 Hertz 60
Manufacturer CLANE Model CCUAOGO4 MB 51 DF 4C4C 361 CEH
Controls: SELM L78CII022 None HOA Switch Motor Starter
Remarks: GOMPRESSORS TRANS CRHM 300C-26 AT R-22 460 V39 SERIAL A 7M 30A 3003 CRHM 300 C-26 AT RLA 240 U H 7M 30A 2999 RLA 55.0

(00 Ton)

Air Cooled Condenser Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY Project Number: 60692,00	
Building: 2/9	
Unit No. ACC Location OFFICE SOUTH MESH Area Served _	BLOG 219 - C-1
Fans: Number 2 RPM Horse	power 7.5 6 F.A EA
Electrical: Volts FLA MCA 25 Manufacturer FLA Manufacturer	
Model CAUA - 8004-0A	
Controls: None Motor Starter HOA Switch	
Remarks:	

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00	
Building: ZMA	
Unit No. G1 A Location RETTR OF 219A Area S	Served
Compressors: Reciprocating Centrifugal Rotary Condenser Type: Air Cooled Packaged Air Cooled Split (Condensing Unit)	Number Z_ Horespower FIA
Electrical: Volts 460 FLA 50 AMP (EA) 2CIRCUITS Manufacturer MANUFACTURE MANUF	Phase 3 Hertz 60
Model CGAAO401 NB 57 C	C4C4C361BBJ
Model	13974 3-83,9-01
Remarks: 2 Compressions 460 V-	30-60 HR RLA 40,0 LA 175

40 TON

Project Name: DELYOR EMS TOOY Project Number: 60692.00	
lilding: 219 A	
Unit No. AHV- 1 Accation AND TORIUM MEZH ROOM	Area Served AUDITORIUM
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water X None 2 PIPE	DX
Heating: Hot Water Electric LENEAT	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter X HOA Switch X
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower 3 Phase 3 Hertz 6	Volts Amps
	1DW3CWU BSH
Return Air Fan: Fan No 7	-0015-1A SECURT K78-141473 None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb
Remarks: FIELD BUILT - W	
2- WAY FNEUMATIC	JAWE FOR WATER
	NEUMATIC CONTENS
JOHNSON CONTROLS N-90	00 ENTHALPY LOGIC CONTROLLER
RC-2 SUMMER CONTROL -	14° 9.24° DA
RC-3 AUMIDITY CONTROL A 3	391. 713 RA

Project Name: FT BUDK EMS STUPY Project Number: 6069200	
ailding: 219	
Unit No. AHU-18 Location SWAH MEH RM	Area Served NTERIOR Ent
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water X None Z FIFE	DX
Heating: Hot Water Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter X HOA Switch X
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower 7.5 Phase 3 Hertz 60	Volts 230/460 Amps 24/12
Manufacturer TRANE CUMATE CHANGE Model TYPE L-31	R SBRIAL# K78C3Z075
Return Air Fan: Fan No	None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb Enthalpy Comparison
Remarks: BAKBEL LOVEMAN PNEUM	1ATIC CONTEORS
Mamatic Sway	
X	

Fan Data Sheet

Project Name: FT BELVEIR EMS STUDY Project Number: 60692.00	, _
Building: <u>2/9</u>	
Unit No. <u>RAF-</u> Location <u>ATTIC</u> BLAS 219	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase Hertz	Volts Amps RPM
ManufacturerModel	
Controls: None Motor	Starter ble Frequency Drive
Remarks:	

Project Name: FT DELVOIR EIMS STUDY Project Number: 60096.00	
ailding: 219	
Unit No. AHUZ Location BASEMENT US ROOM	Area Served UPS Room
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DXX
Heating: Hot Water Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter HOA Switch
nfiguration: Blow-Thru Draw-Thru	Horizontal Vertical
Motor Horespower Phase Hertz	Volts 115/208-230 Amps 17.4
ManufacturerCARCIGU	4007-3016A
Return Air Fan: Fan No	None X
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb Enthalpy Comparison
Remarks: NOT OPERATING AT TIME	OF GURVEY
7	

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FI BELVOIR L Project Number: 60092,00	BMS STUDY
Project Number: 60642,00	
Building: 219	
Unit No ACW- Location BEHIND	BLOW Area Served AHU-Z (UPS ROOM)
Compressors:	
Reciprocating	Number
Rotary	Horespower
	RLA 13.5
Fans:	LRA 69
Number	
RPM	Horsepower
Electrical:	
Volts 460	Phase 3
MCA 18.1	Hertz <u>6</u> 6
Manufacturer CARRIE	
Model 38AFP 00	7 600
Controls:	
None HOA Switch	Motor Starter
TIOA SWILCH	
Remarks:	

Fan Data Sheet

Project Name: FT BEZVOR BMS STUDY Project Number: 60692.00	,
Building: <u>219</u>	,
Unit No. Ef / Location	Area Served
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase Hertz	Volts Amps RPM
ManufacturerModel	
Controls: Moto	r Starter ble Frequency Drive
Remarks:	

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00
Building: 219
Unit No.†\(\tau\)-A Location Area Served
Cooling: Chilled Water X None
Heating: Hot Water Steam Electric KW None
Fan Motor Horespower
Electrical: Volts Phase Hertz FLA
Manufacturer RANE Model B22AB02
Controls: Self Contained Remote Outside Air
Remarks: Z PIPE W/ ELECTRIC CONTROL VALVES

Project Name: FT BELV Project Number: 60692,00	OIR EMS	STUDY .	:	:	7
Building: <u>2/9</u>					·
Unit No. FLO-B Location		Area Served			_
Cooling: Chilled Water None					_
Heating: Hot Water Steam Electric None	_ KW				
Fan Motor Horespower 1/30 Phase Hertz		Volts Amps RPM			
Electrical: Volts 15V Hertz 60		Phase	e talere e		
Manufacturer TRA	NE B2	2A003			- -
Controls: Self Contained Outside Air		Remote			
Remarks:	PIPE	W EVERTRIC	2-way	Control	VALVE
					- -
					- - -
					- -

Project Name: FT BELVOIR EMS S Project Number: 60698.45	STUDY
Building: 2/9	
Unit No. FULD Location	Area Served
Cooling: Chilled Water None	
Heating: Hot Water Steam Electric KW None	
Fan Motor Horespower 1/30 Phase Hertz	Volts Amps RPM
Electrical: Volts Hertz	Phase FLA
Manufacturer TLAN Model	B22A004
Controls: Self Contained Outside Air	Remote
Remarks: Z PIPE	W/ EVERTRIC CONTROL VALVE

Project Name: HELVOIR EMS Project Number: 60612,00	<u>s svoy</u>	
Building: 2/9		
Unit No Far E Location	Area Served	
Cooling: Chilled Water		
Heating: Hot Water Steam Electric KW None		
Fan Motor Horespower Phase Hertz	Volts _// S Amps RPM	
Electrical: Volts Hertz	Phase FLA	r s g
Manufacturer TRANE Model	522 Acide	;
Controls: Self Contained Outside Air	Remote	d
Remarks: Z	PIPE W/ ELECTRIC CONTRO	L VALVE

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00
Building: 219
Unit No. FWF Location Area Served
Cooling: Chilled Water None
Heating: Hot Water
Fan Motor Horespower 1/12 Phase Amps /.6 Hertz RPM
Electrical: Volts Phase FLA
Manufacturer
Controls: Self Contained Remote Outside Air
Remarks: 2 PIPE W ELECTRIC CONTROL VALVE

A - 44

Project Name: TT FELVOIR EMS STUDY Project Number: 60692, us
Unit No. P-1A Location PASSIBLET Area Served AUDITORIUM
Motor:
Horespower 2 Phase 3 Hertz RPM 3450 Volts 208/230-460 Amps 6.3/6.2-3.1
Manufacturer
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks:

Project Name: FT BELVOIR EMS STOWY Project Number: 60672.60
Building: <u>219</u>
Unit No. P-1 Decation BASEMENT MERHEM Area Served Pure TEMPERATURE UNITE.
Motor: Horespower 5 Phase 3 Hertz 60 Nolts 236/466 Amps 14.4/7.2 RPM 1745
Manufacturer BELL & GOSSETT Model SBR 183 1510 2BB 8-3/4 BF SER 182 No. 847504
None Variable Frequency Drive Motor Starter HOA Switch
Remarks: END SUCTION BASE MOUNTED

Project Name: FT GOLVOIR ENGS STUDY Project Number: 60692,00
Building: 219
Unit No. 22 Location BREMENT MEM Area Served Steam Condensate Fund
Motor: Horespower 3/4 (Z) Phase Hertz Notes 230/460 Amps 216/1.3
Manufacturer Model
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks:

BUILDING 247

Boiler Survey Data Sheet

Project Name: Ft Belvoir EMS Study Project Number: 60692.00
Building: <u>247</u>
Unit No. B-1 Location BASEMENT MECH AreaServed
Type: Cast Iron Steel Steel Steam
Capacity: Input Rating MBH Net Rating MBH
Manufacturer WEIL MC/AN
Model
Burner: Gas / Input 4474 MBH Input 3 Gal/Hr
Manufacturer West CR
Model 1820-30-R77950 LL, 25 STRIAL WO19685-
Controls: None Automatic Feedwater Valve Low Water Cut-off Make-up Water PRV
Remarks: OAST

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Boiler Survey Data Sheet

Project Name: Ft Belvoir EMS Study Project Number: 60692.00 Start Ft Belvoir EMS Study Project Number: 60692.00	
Building: 247 Unit No. 3-2 Location BREMENT NECH AreaServed	
Type: Cast Iron	
Capacity: Input Rating MBH Net Rating MBH	
Manufacturer WB/L-MC(A)	
Model	
Burner: Gas Input 4474 MBH Input 31 Gal/Hr	
Manufacturer WEBSTEK Model JB2C-30-R7795C-U.25 SERVIC WO19685	. ;
Controls: None Automatic Feedwater Valve Low Water Cut-off Make-up Water PRV	
Remarks:	
·	

Chiller Survey Data Sheet

Project Name:Project Number:	· · · · · · · · · · · · · · · · · · ·
Building:	
Unit No C. Location	Area Served
Compressors: Reciprocating Centrifugal Rotary	Number Horespower FLA
Condenser Type: Air Cooled Packaged Air Cooled Split (Condensing Unit)	Air Cooled Remote (Condenser \) Water Cooled (Cooling Tower)
Volts 460 FLA	Phase 3 Hertz 100
Manufacturer YUKA Model YT B2	C3 C1- CKP
HOA Switch	Motor Starter X WESTINGHOUSE
Remarks: R-11 M	CA 314 MOCP 600
COMPRESSOR GALLAL NO Y	YDTS-85 COPE KY CTM - 083252
305 AMP 1	1 do - 30 - 60 hz
NOMINE 300 ,66-	71
2- Press 213 @ -14°	ENING
950 EXPERIENCES	
900 andony	-

Cooling Tower Survey Data Sheet

Project Number: 60692.00	S STUDY
Building: <u>24</u> 7	
Unit No. <u>C7-1</u> Location <u>OV75108 6011</u>	- L Rm Area Served
Configuration: Draw Thru Blow Thru	Standard Height Low Silhouette
Motor: High Speed: Horespower Phase Hertz 166	Volts 200 Amps 44, 8 RPM 1765
Low Speed: Horespower Phase Hertz	Volts Amps RPM
Manufacturer MARLEY Model	
	8708 6-379-85 Dile Frequency Drive Speed Motor
Remarks:	

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BECVOIR	EMS STUDY	
Project Number: 60692.00	e e	:.
Building: <u>247</u>		
Unit No. ACCU- Location PENTHOU	SE MECH Area Served AUDIT	GOUM AHU
Compressors: Reciprocating Rotary	Number Horespower FLA	<u>120</u> 142/11
Fans: Number RPM	Horsepower	
Electrical: 2 20/446 FLA	Phase Hertz	
Manufacturer CHLYCOK Model 200	MIR EMP - FADIAL	76 A o
Controls: None HOA Switch	Motor Starter X	,
Remarks: W/ REMOTE C	ENTENIER ACC-1	
UNIT 15	DISCONNECTED TRUM	DX 601C
CONTROLS	S HAVE CEEN DISA	E16D

Air Cooled Condenser Survey Data Sheet

Project Name: FT BELVOIR EN Project Number: 60692,00	15 STODY
Building: <u>24</u> 7	
Unit No. ACCI Location ROOF	Area Served AUCHTORIUM (ACCO-1)
Fans: Number / RPM	Horsepower
Electrical: Volts 466 FLA 11	Phase $\frac{7}{66}$
Manufacturer THANE Model	CAVB(2042 ADI
Controls: None HOA Switch	4661112 0856 60502 Motor Starter
Remarks:	

Project Number: 60692	LVOIR EMS STUDY
.11ding: <u>24</u> 7	
Unit No. AHU Location	Area Served AUDITORIUM
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX _X
Heating: Hot Water Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	
nfiguration: Blow-Thru Draw-Thru	Horizontal
Motor Horespower 10 Phase 3 Hertz 60	Volts 208 Amps 30 (RM 1750
ManufacturerModel	FIED BUILT-UP
Return Air Fan: Fan No	None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	
Remarks:	PNEUMATIC 3-WAY CONTROL FROM THE HOT WATER
	PAJELMATIC DAMPER ACTUATOR FOR RETURN OA.
	RABBERGYEN RECEIVER CONTROLLER (ABLING
	JOHNSON CONTROLS T-8000 - PROP ACTING 7.5-47
	RIGHT GUMM GRADIAN GUITCH AND ROBBILE ROBULTE
	The Court MED INNING THE STATE OF THE COMMENT AND ACT IN

Project Name: FT BELLOIR EMS STUDY Project Number: 60692.00	
.ilding: <u>247</u>	
Unit No. AHV-1BLocation	Area Served
Air Type: Constant Volume	Variable Volume
Zone Type: Single Zone	Multi-Zone
Cooling: Chilled Water None	DX
Heating: Hot Water Electric	Steam None
Supply Fan: Forward Curved Backward Incline Airfoil	Controls: Inlet Vanes Variable Frequency Drive Motor Starter HOA Switch
nfiguration: Blow-Thru Draw-Thru	Horizontal / Vertical
Motor Horespower Phase Hertz	Volts Amps
Manufacturer TRANE Model FIN HETTER MCCA DOSGER	
Return Air Fan: Fan No	None
Economizer Controls: None Outdoor Enthalpy Drybulb Comparison	Outdoor Drybulb Enthalpy Comparison
Remarks: 1000 CONTROLS Remarks: 1000 CONTROLS	RELECTRIC ASTRACT HOT WATER LUATER
ELECTED OUTSIGN	& PIR DAMPER ACTUATOR
JAANGE OVER AQUASTAT LELECTIVEL COLL	9 Mora CHILLED
JOHNSON TIME CLOCK	-56 SALES ENC. SOG TYT 18

Fan Coil Unit Survey Data Sheet

Project Name: TT BELYOIR EMS STUDY Project Number: 60692.00
Building: 247
Unit No. FC- Location Area Served
Cooling: Chilled Water None
Heating: Hot Water Steam Electric KW None
Fan Motor Horespower Volts Phase Amps Hertz RPM
Electrical: Volts
Manufacturer NTERNATIONAL ENVIRONMENTAL COYOF. Model
Controls: Self Contained Remote Outside Air
Remarks: Z WAY ELECTRIC CONTROL VALVE
Z- PIPE HEATING/COOLING

Project Name: TT BELVOIR EMS STUDY Project Number: 60692, 60
Building: 247
Unit No. Location BASEMENT MECH Area Served HEATING FIME
Motor: Horespower 7,5 Phase 3 Hertz 200 Manufacturer Model Model The 12369-2 746 361 67 128 2,5 × 9
Manufacturer HIKOKA YUME
Model 76-12369-2 748 361 65 - 378 2.549
Controls:
None Variable Frequency Drive Motor Starter HOA Switch
Remarks: WPE MONTCH
DOMINGON LONGERS T-5800-3 PROFIT RECEIVER COM
160 GFM
750 KMM

Project Number:	-
	Area Served HEATTING WATER PUNC
Motor: Horespower 5 Phase Hertz	Volts <u>208/230 - 460</u> Amps <u>15.2/14.4 - 7.2</u> RPM <u>1150</u>
Manufacturer TAZO Model FM 5010	8,3 BZG101 LO
Controls: None Variable	e Frequency Drive
Remarks: W REM	TE BULB T-57413 FOR O.A.
Bithe fi	TOUNTED ENV FUETION CENTRIFICAL

ALL SOMETHING

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			CIEC	To View
Project Name:		Į		
Project Number:		÷		
Building:				ood Stem
Unit No Location	Area Served _	AUT WATER	and and	ROM
Motor:	(1)			
Horespower 43 Phase 4	Volts <u>US</u>			
Phase 1 Hertz 10°	Amps 77 <			
	7			
Manufacturer TAZO	INLINE CIRCUL	ATOX	rlea	
Model			3/0/	
Controls:				
None	Variable Frequency Drive HOA Switch			
Remarks:				

RIGHT

Project Name: FT BE Project Number: 600	ELYOIR EMS STUDY	¥		
Building: 247				
Unit No. 69 Location 4	EREMENT MECH KOOM	Area Served	SHELLD WATTER	* Fung
Motor: Horespower 10 Phase 3 Hertz 6	Volt: Amp RPM	s 208 0s 28 1 1740		
Manufacturer	-12194-2	5125	68PA-6F 445×98	
Controls: None Motor Starter	Variable Freq HOA Switch	uency Drive		
Remarks:				
~				

Project Name: FT BEZVOIR EMS STVDY Project Number: 60692.00
Building: 247
Building: 247 Unit No. 16 Location BASEMENT MECH Area Served CONDANSER WATER FURTHER FURTHER TOPPER
Motor: Horespower 16 Phase 3 Hertz 109 RPM 1750
Manufacturer Aukukk
Model 967-12745-1 798 6614-6=
Controls: 5x6x9
None Variable Frequency Drive Motor Starter HOA Switch
Remarks: 702 6Pm 37.5 FT

Project Name: FT BELLOK Project Number: 60692, 60	ENS STUDY
Building: <u>24</u> 7	
Unit No Location Brief	KOOM Area Served Lawrence WATER
Motor: Horespower	Volts 27.4 / 13.7 RPM //45
Manufacturer AVCOVA	
Model	8-5918 7418 344A - SF SIZE 5 X6 X11
Controls:	5/28 5 X6 X(1)
None Motor Starter	Variable Frequency Drive
Motor Starter	HOA Switch
Remarks:	702 6PM 37,5FT
	1160 RTM
1111	

BUILDING 1425

Chiller Survey Data Sheet

Project Name: T BELVOIR EMS STUDY Project Number: 60692.00	
Building: 1425	
Unit No. 61 Location OUTSIDE FAST Area S	erved
Compressors: Reciprocating Centrifugal Rotary	Number 3 Horespower RLA 34 4 LLA 247
Condenser Type: Air Cooled Packaged Air Cooled Split (Condensing Unit)	Air Cooled Remote (Condenser) Water Cooled (Cooling Tower)
Electrical: Volts ZOO FLA MCA 184	Phase 3 Hertz 60
Manufacturer TCANE Model CGAD CHOGAF A 16 TUR	LANGE AN J92H83099
Controls: None Motor Starter _ HOA Switch	
Remarks:	

Fan Coil Unit Survey Data Sheet

Project Number: 4069	72.00	
Building: <u>1405</u>	·	
Unit No. FCU-1 Location _	Area Served	
Cooling: Chilled Water None Heating: Hot Water Steam Electric None None	20116	
Fan Motor Horespower Phase Hertz	Volts Amps RPM	
Electrical: Volts Hertz	Phase FLA	
Manufacturer	UNVE	
Controls: Self Contained Outside Air	Remote	
Remarks:	3- WAY STRUCK CONSTROL VALVE	

Fan Data Sheet

Project Name: TOELVOIR EMS S Project Number: (60692,00	TOWN TO THE RESERVE OF THE PERSON OF THE PER
Building: 1425	•
Unit No. EF-1 Location RODF	Area Served RESTROOM BUNGAUST
Fan Type: Power Roof Ventilator Utility Fan Inline Centrifugal Ceiling Centrifugal	Forward Curved Backward Incline Airfoil
Motor: Horespower Phase Hertz	Volts Amps RPM
ManufacturerModel	
Controls: None	Motor Starter Variable Frequency Drive
Remarks:	

Project Name: FT BELVOIR LMS STUDY Project Number: 60692.00
Building: 1425
Unit No. P Location BASEMENT MECH Area Served CHICLEP/HENTING WATER
Motor: Horespower 5 Phase 7 Hertz 60 RPM 170
Manufacturer MINA AMTROL ITHEREN PUNOS Model 1/4 x 1/2 x 988 SERIES 2 300
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks: 195 6PM @ 75 Fy HEM

A-70

Project Name: FT BELVOIR EMS STUDY Project Number: 60692,00		
Building: 1425		
Unit No. P-2 Location FARENENT MEGH Area Served CHILLED/HEATING WATER KLOM STANDBY		
Motor:		
Horespower Volts		
Phase Amps Hertz RPM		
Manufacturer		
Model		
Controls:		
None Variable Frequency Drive		
Motor Starter HOA Switch		
Remarks:		

SAME to Run P1

BUILDING 3136

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY Project Number: 60692.00	
Building: 3136	
	a Served
Compressors: Reciprocating X Centrifugal Rotary	Number $\frac{2}{1}$ Horespower $\frac{1}{1}$ LRA $\frac{394}{72.2}$
Condenser Type: Air Cooled Packaged Air Cooled Split (Condensing Unit)	Air Cooled Remote (Condenser) Water Cooled (Cooling Tower)
Electrical: Volts 200 FLA M(A 179 Manufacturer TLANE	Phase Hertz
Model CGACO	2406 KANEE 4236
Controls:	J8 8A G069
None Motor Starte HOA Switch	r
Remarks: 4 Compress !	AS 4,1 FLA EXCI
	HORSE POWER
ON PLACE PROPERTURE :	Med Rom
	AND CHANGE NEX

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIL EMS STUDY Project Number:	<u>(</u>
Building: <u>3136</u>	
Unit No. My Location	Area Served
Cooling: Chilled Water None Heating: Hot Water Steam ElectricKW None	2 PIPE
Fan Motor Horespower Phase Hertz	Volts Amps RPM
Electrical: Volts Hertz	Phase FLA
ManufacturerModel	
Controls: Self Contained Outside Air MANNAC	Remote
Remarks: No	CONTROL VALVES
WINDOWS OREN BE	LANGE HET WKTER IS ALWAYS

Project Name: Fr BELYOIR EMS STUDY Project Number: 60092,00
Building: 31-3/
Unit No. PI Location FAT-MENT MECH Area Served CHILLED HEATING WATER
Motor: Horespower 5 Phase 3 Hertz 60 Note: $2006 \cdot 230/460$ Amps 3150 RPM 3150
Manufacturer
Controls: None Variable Frequency Drive Motor Starter HOA Switch
Remarks:

APPENDIX B MECHANICAL EQUIPMENT LOCATION PLANS

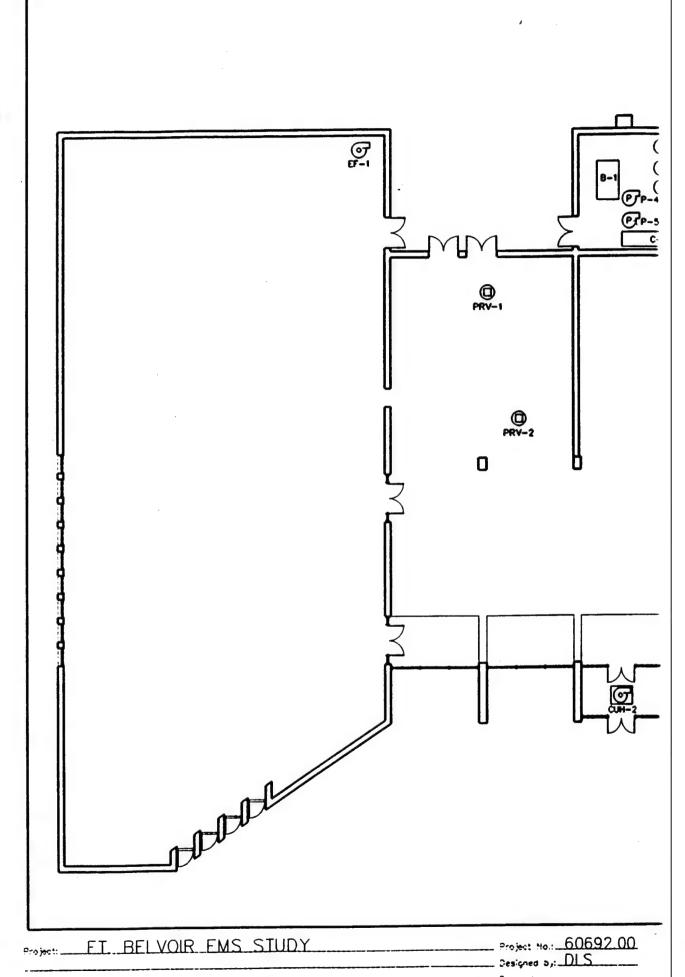
BUILDING 200

Einhorn Yaffee Prescott



ARCHITECTURE & ENGINEERING, P.C. THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL. (518) 463-2141

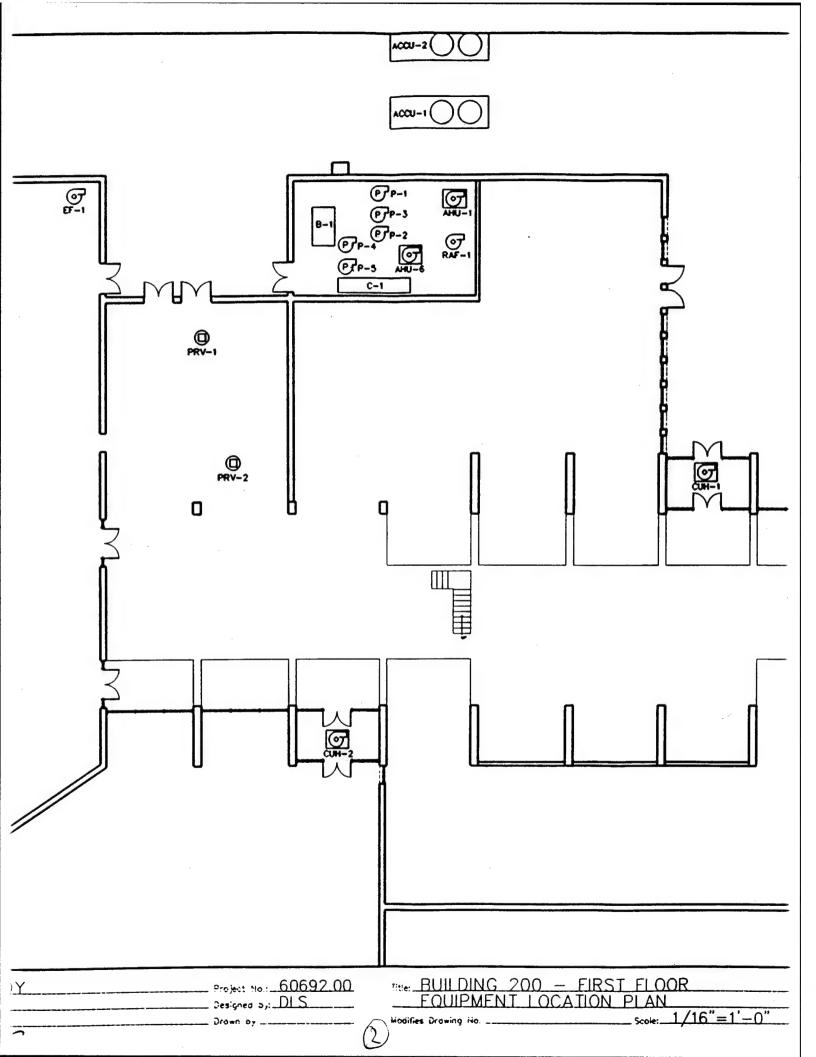
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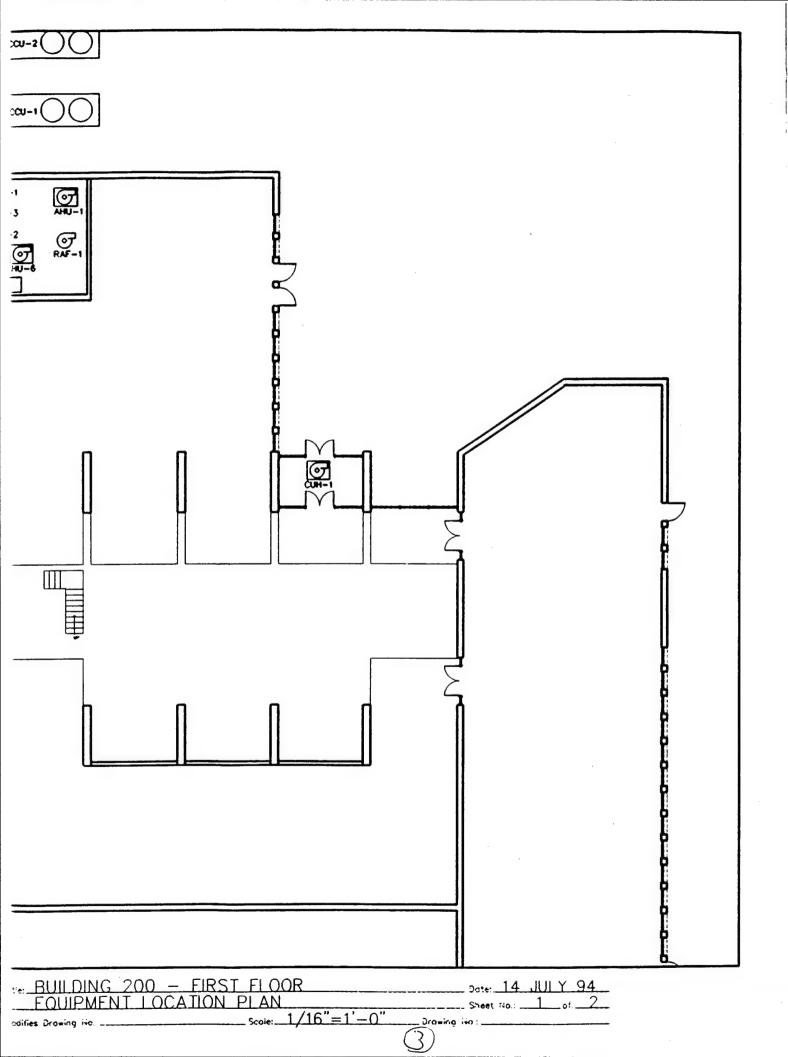


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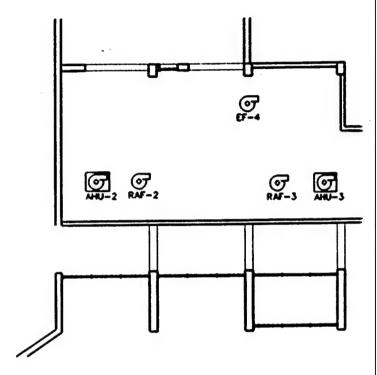
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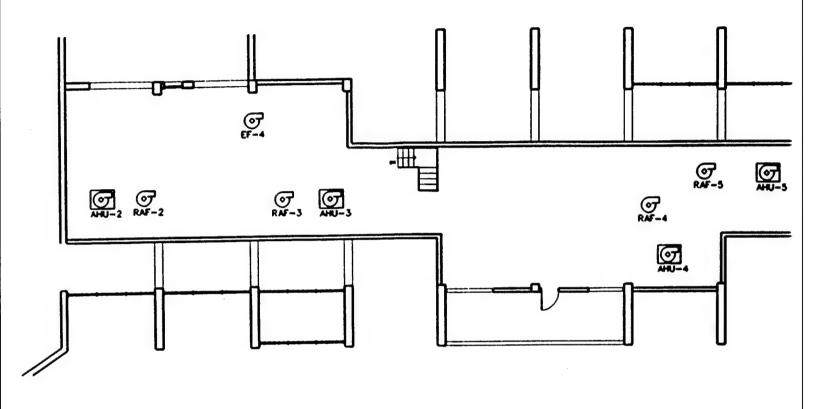
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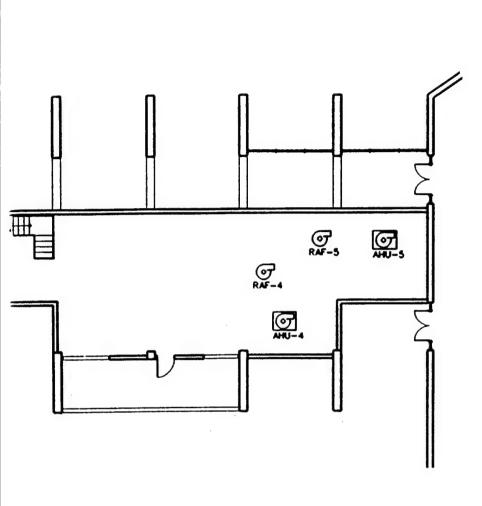
THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 TEL (202) 471-5000



Project: FT. BELVOIR EMS STUDY	Project No - 60692.00
B37(1)	Drown by:
$D \supset \mathbb{C}$	



Y Project No 60692.00	BUILDING 200 - MEZANINE
DIS	FOUIPMENT LOCATION PLAN
Drawn by	Hodifies Drawing incScale1/16"=1'-0"
	·



BUILDING 219

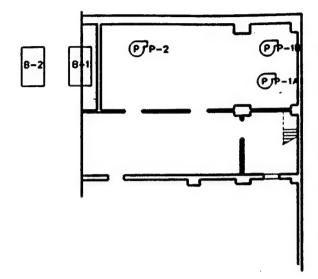
Einhorn Yaffee Prescott

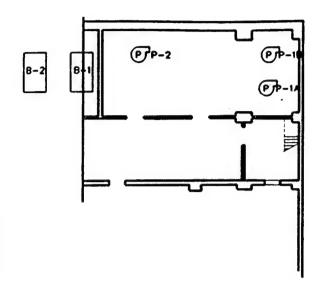


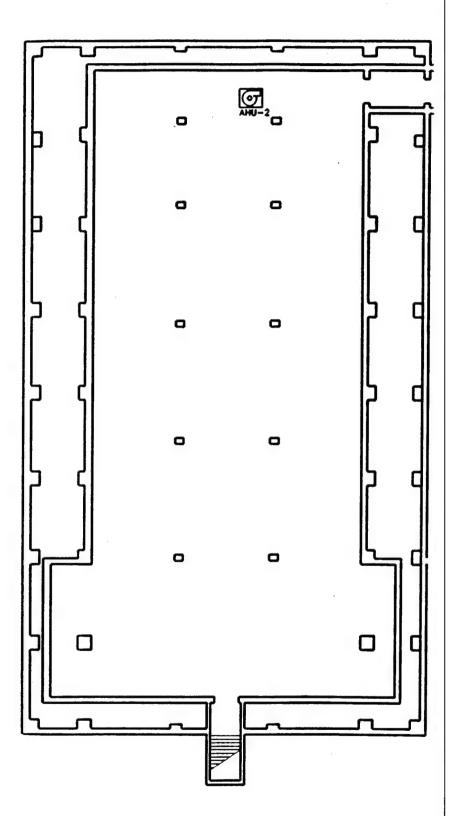
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THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL. (518) 463-2141

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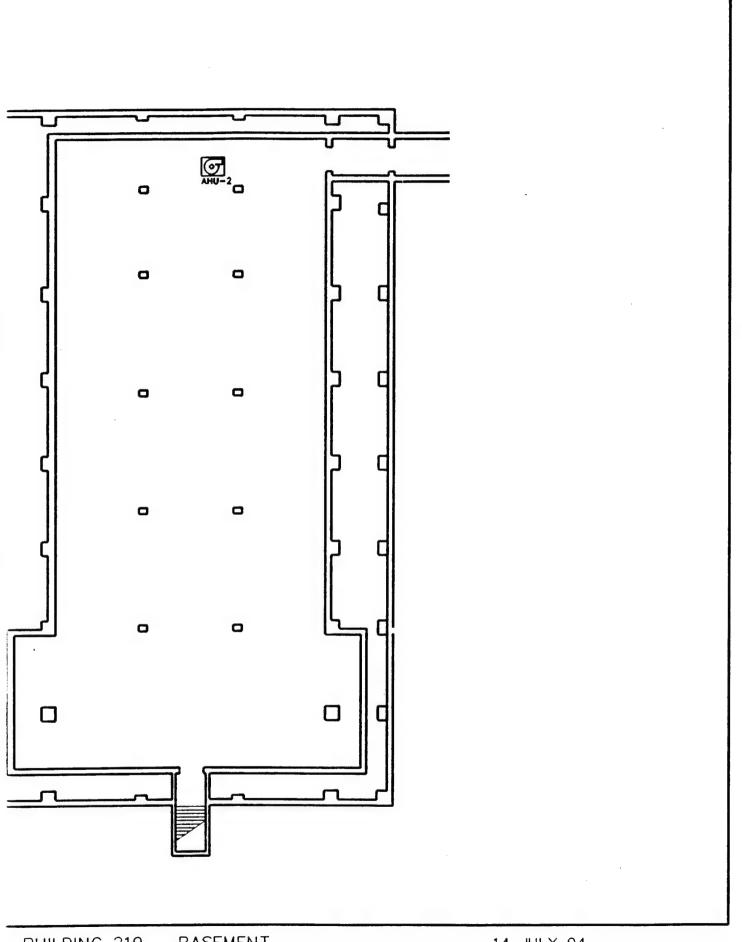




 Project No.:	_60692.00
 Designed by	
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BUILDING 219 - BASEMENT FQUIPMENT LOCATION PLAN

Modifies Drawing No. ________Scale: 1/16"=1'-0



BUILDING 219 — BASEMENT

FOUIPMENT LOCATION PLAN

Sheet No.: 1 of 3

Stiffes Drawing No. Scale: 1/16"=1'-0" Drawing No:

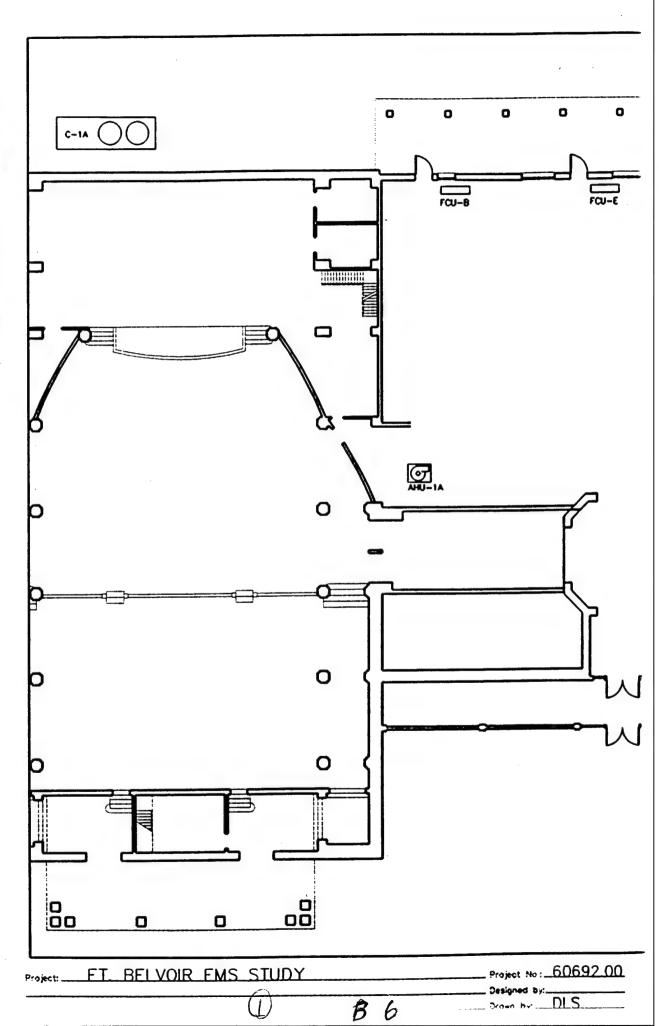
Einhorn Yaffee Prescott



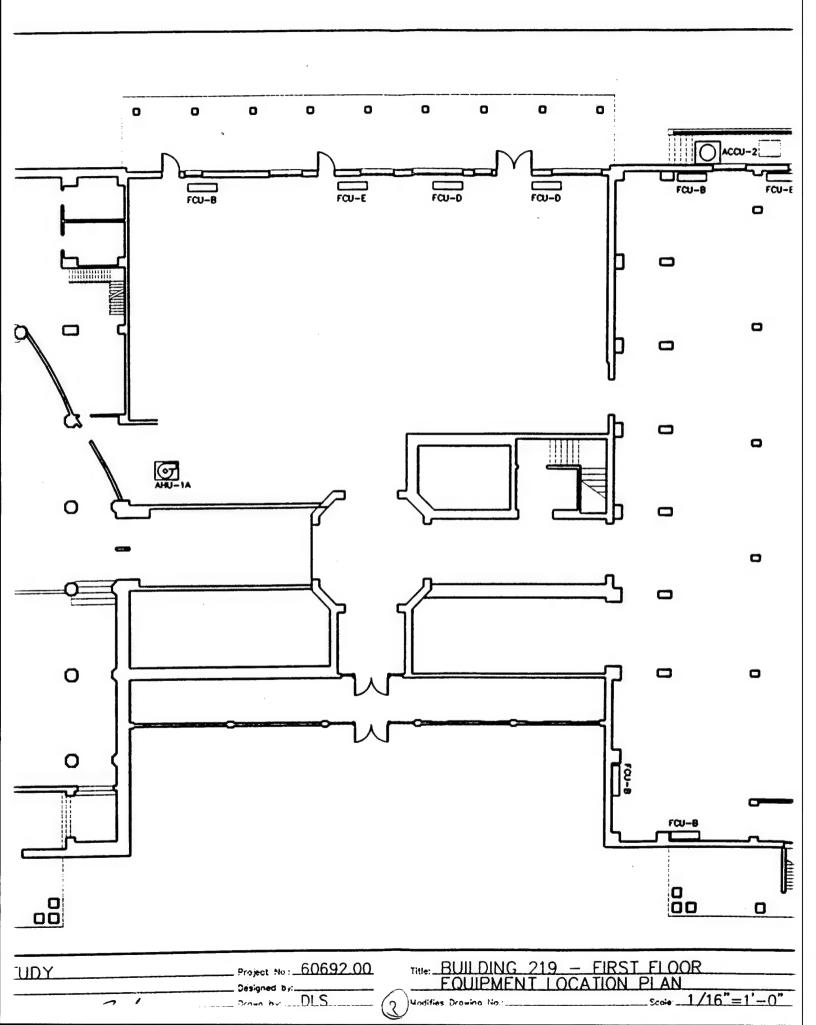
ARCHITECTURE & ENGINEERING, P.C.

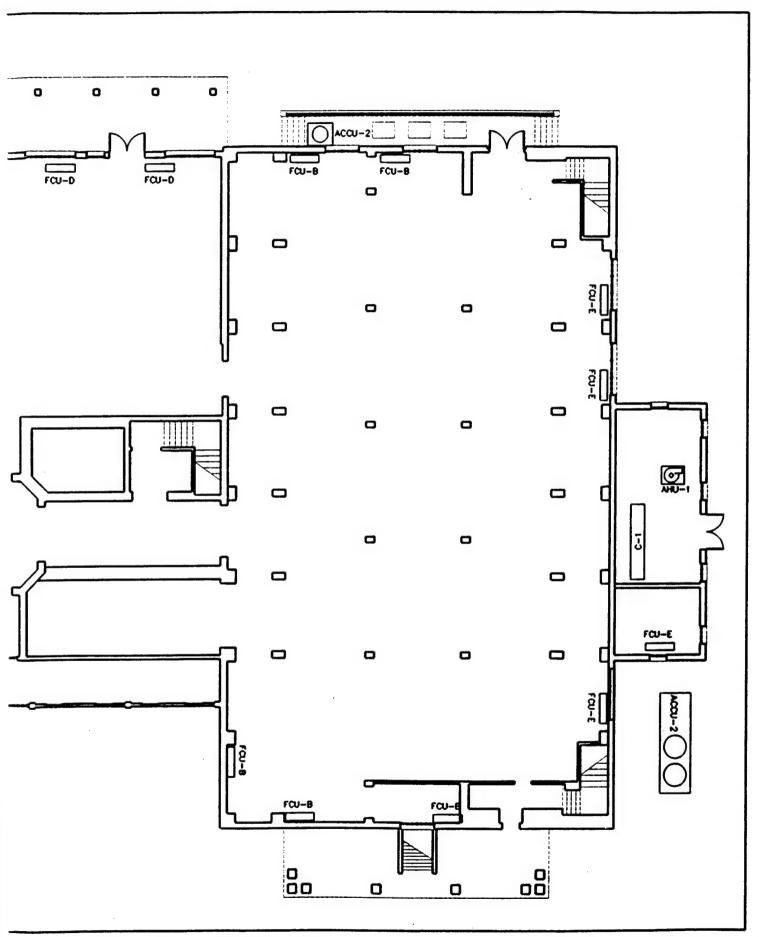
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THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 TEL (202) 471-5000



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Title: BUIL DING 219 - FIRST FLOOR Date: 14 JULY 94

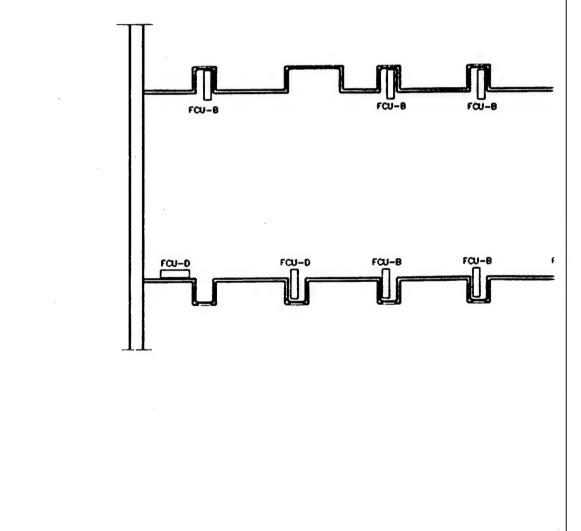
FQUIPMENT LOCATION PLAN Sheet No.: 2 of: 3



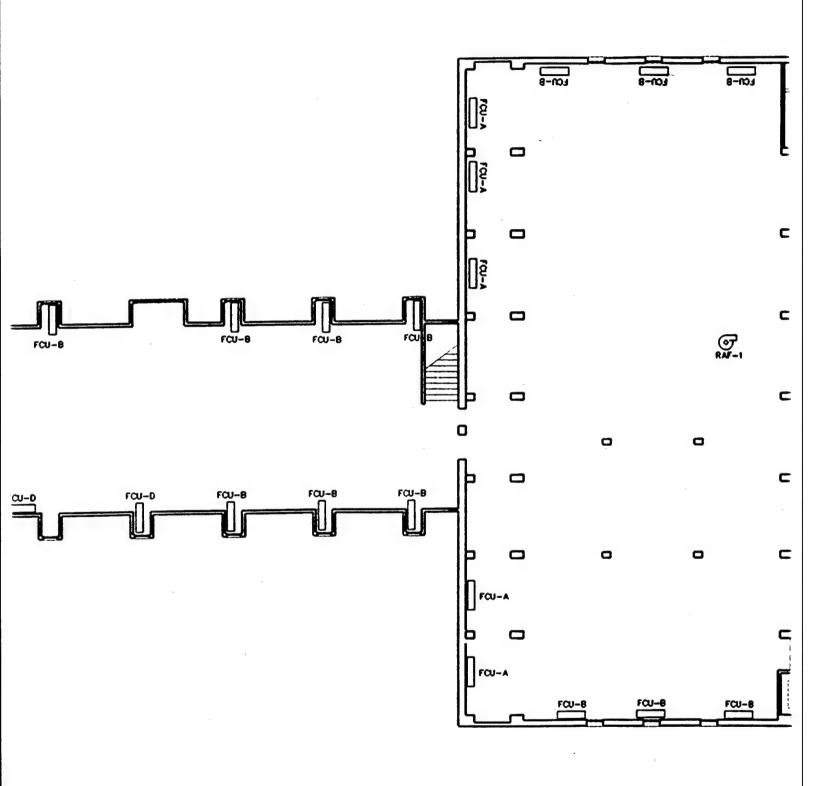
ARCHITECTURE & ENGINEERING, P.C.

THE ARGUS BUILDING
BROADWAY AT BEAVER
POST OFFICE BOX 617
ALBANY, NY 12201-0617
TEL. (518) 463-2141

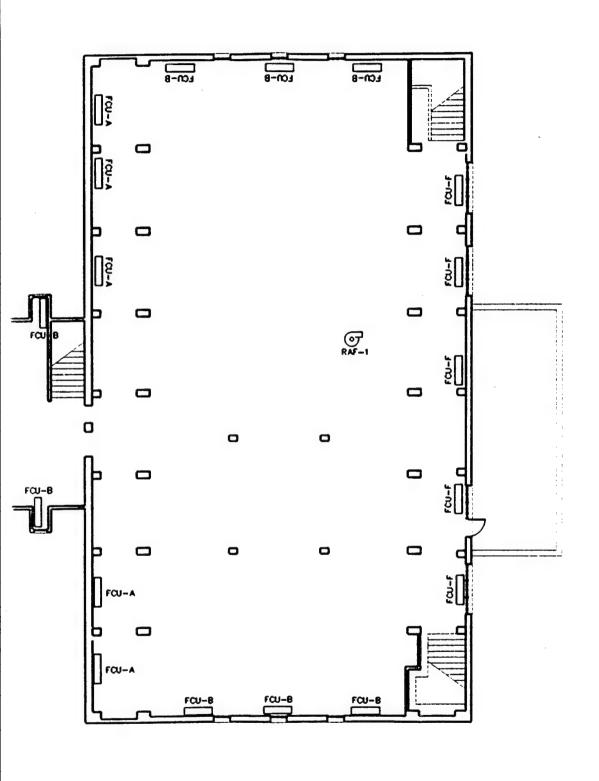
THE FLOUR MELL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 TEL (202) 471-5000



FT. BELVOIR EMS STUDY Project No.: 60692.00 Cuecked Dr.



STUDY	Project No.: 60692.00	FOUIPMENT LOCATION	
		Modifies Drawing No.:	Scoie: 1/16"=1'-0"



Title: BUILDING 219 — SECOND FLOOR

FOUIPMENT LOCATION PLAN

Sheet No.: 3 of: 3

Modifies Drowing No.: Scoie: 1/16"=1'-0" Drowing No.:

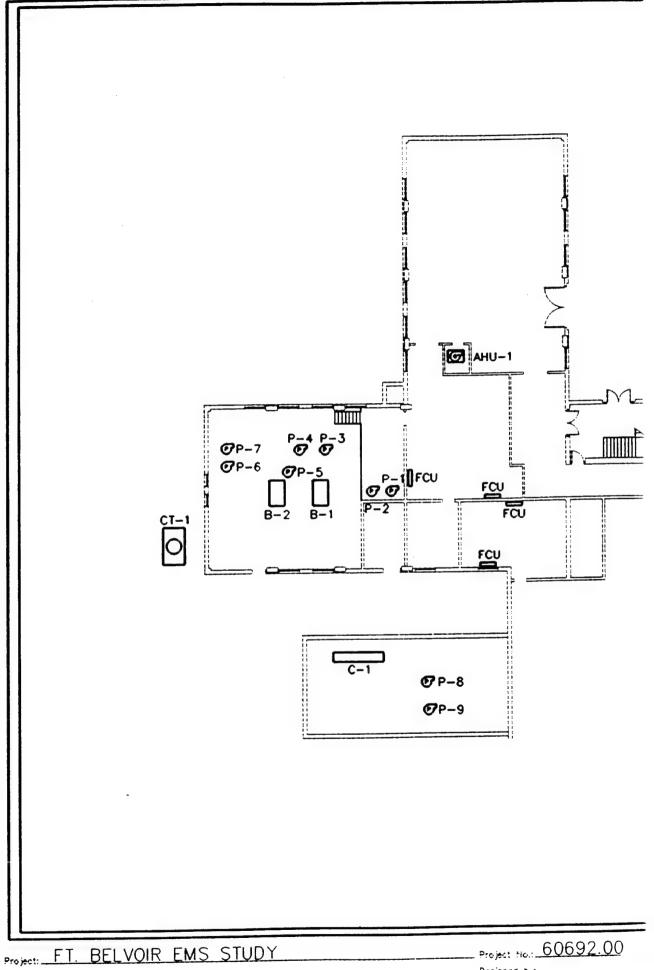
BUILDING 247



ARCHITECTURE & ENGINEERING, P.C.

BHE ARRUS BUILDING BROADWAY AT BEAMER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL (518) 463-2141

THE FLOUR MILL 1000 POTOMAC ST., NW MASHINGTON, DC 20007 TEL. (202) 471-5000

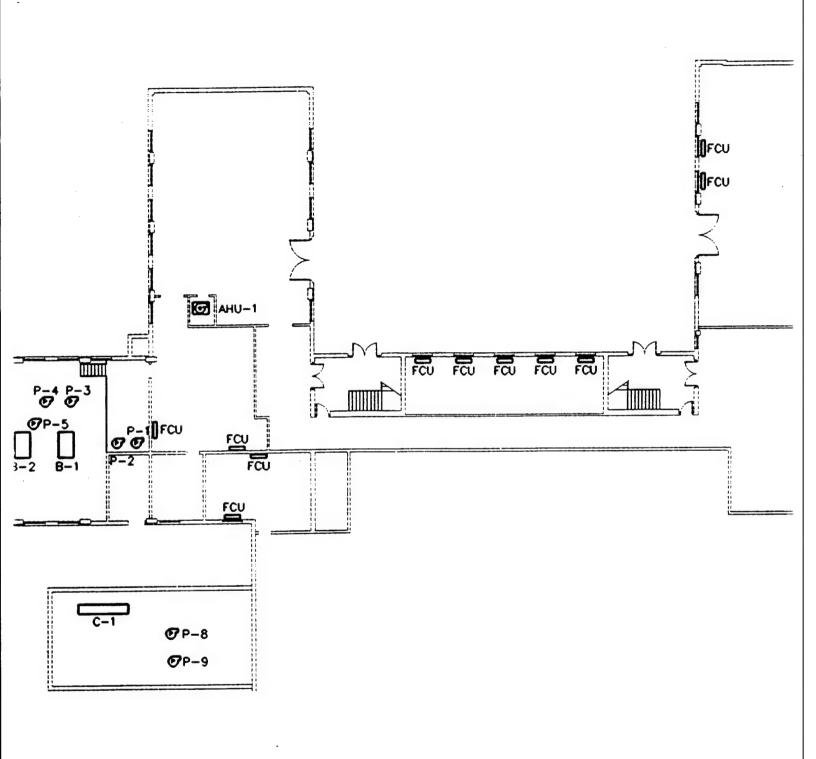


Project: FT. BELVOIR EMS STUDY

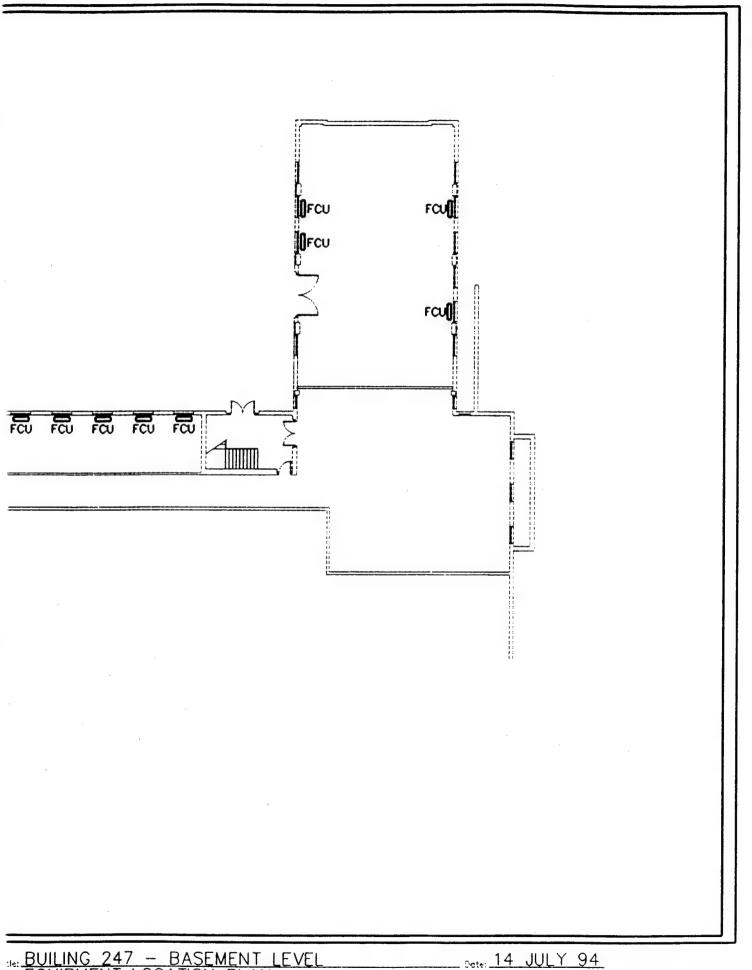
Project flo.: 60692.00

Designed by: FE/DS

Drawn by FE/DS



1	Project Ho.: 60692.00	Fitte: BUILING 247	- BASEMENT LEVEL
	Designed by:	<u>EQUIPMENT L</u>	OCATION PLAN
	Drawn by FE/DS	Modifies Drawing No.	scole: NONE
6-9	())	



tle: BUILING 247 — BASEMENT LEVEL Octe: 14 JULY 94

EQUIPMENT LOCATION PLAN Sheet No.: 1 of 5

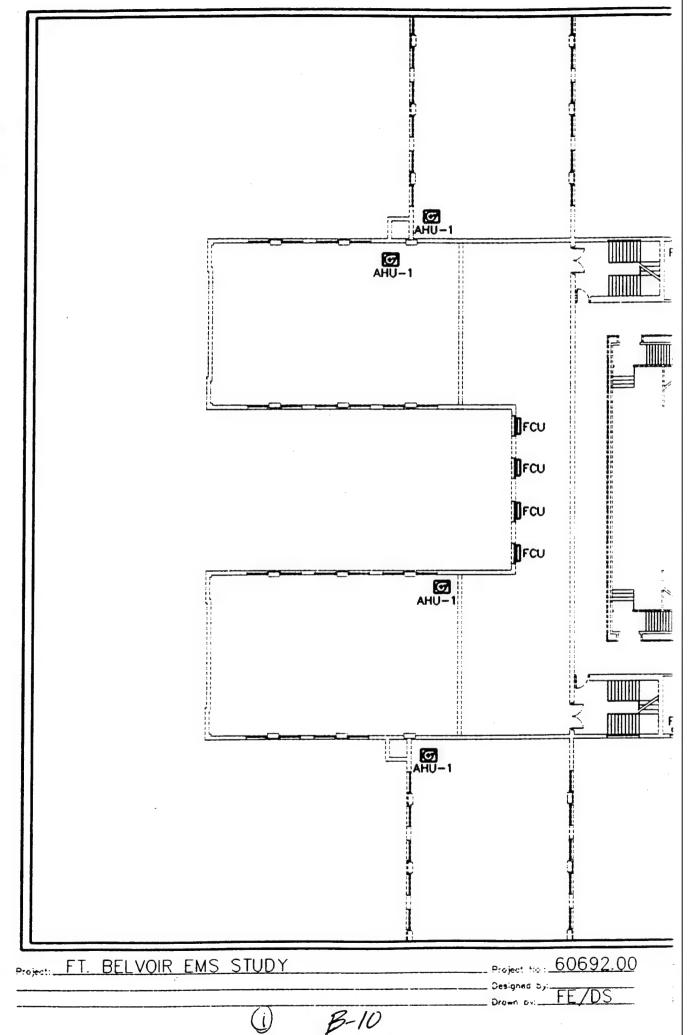
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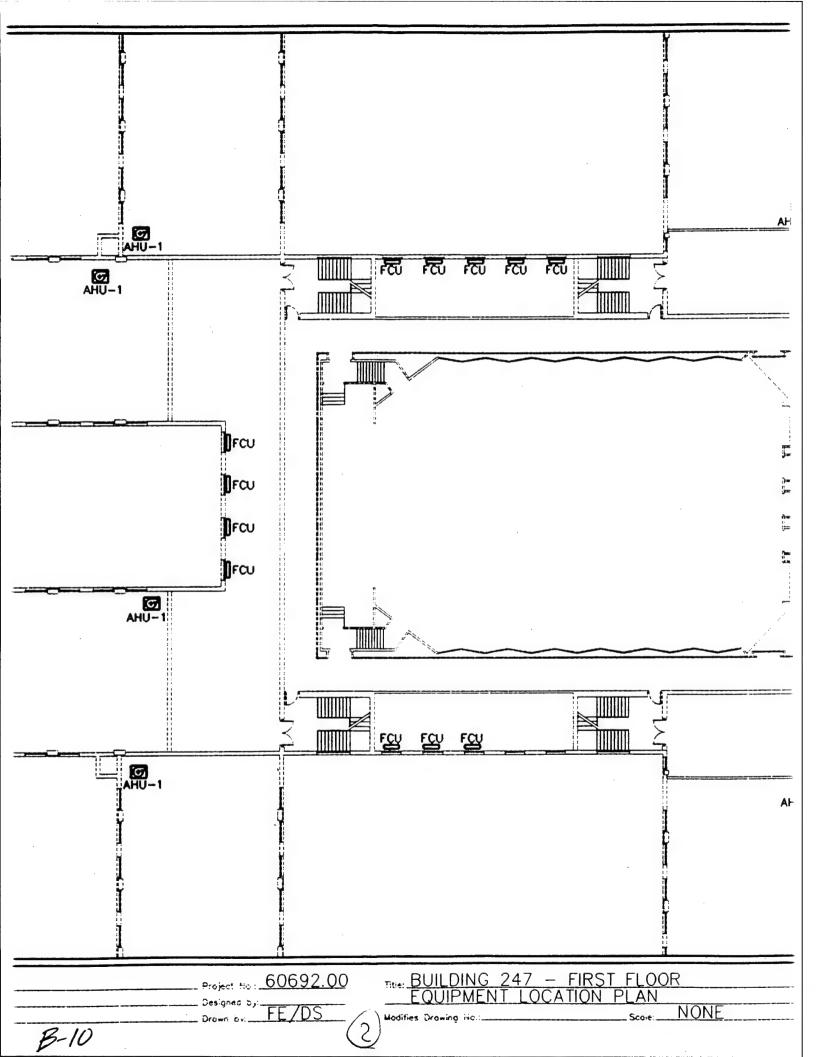


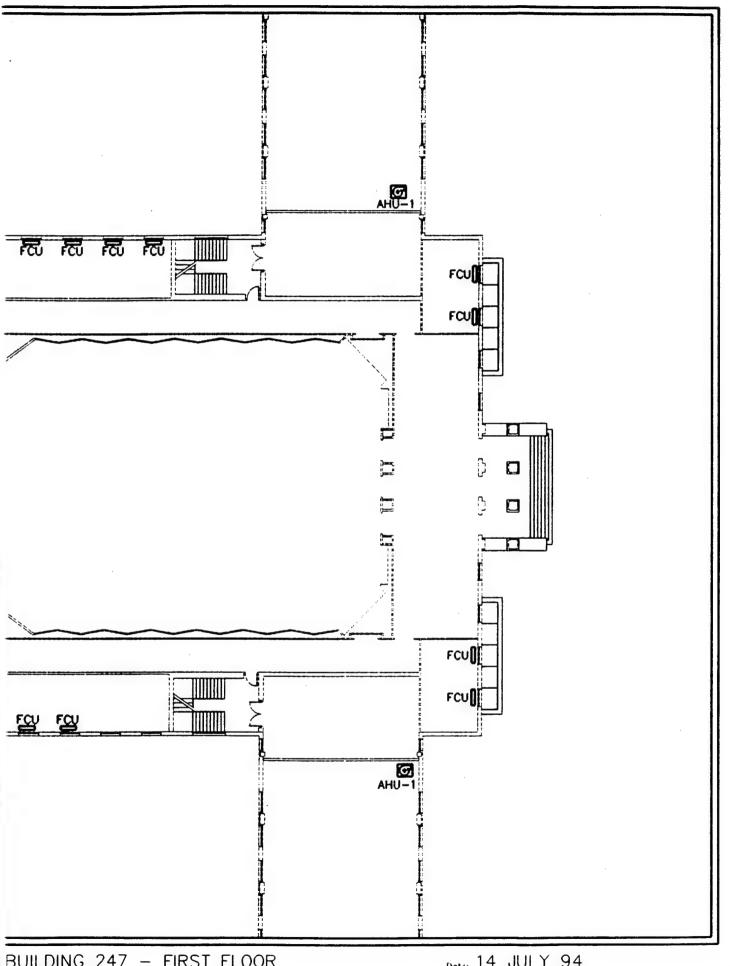
ARCHITECTURE & ENGINEERING, P.C.

THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL (518) 463-2141

THE FLOUR MELL 1000 POROMAC ST., NW WASHINGTON, DC 20007 TEL. (202) 471-5000







BUILDING 247 - FIRST FLOOR

FOUIPMENT LOCATION PLAN

Sheet 16:: 2 of: 5

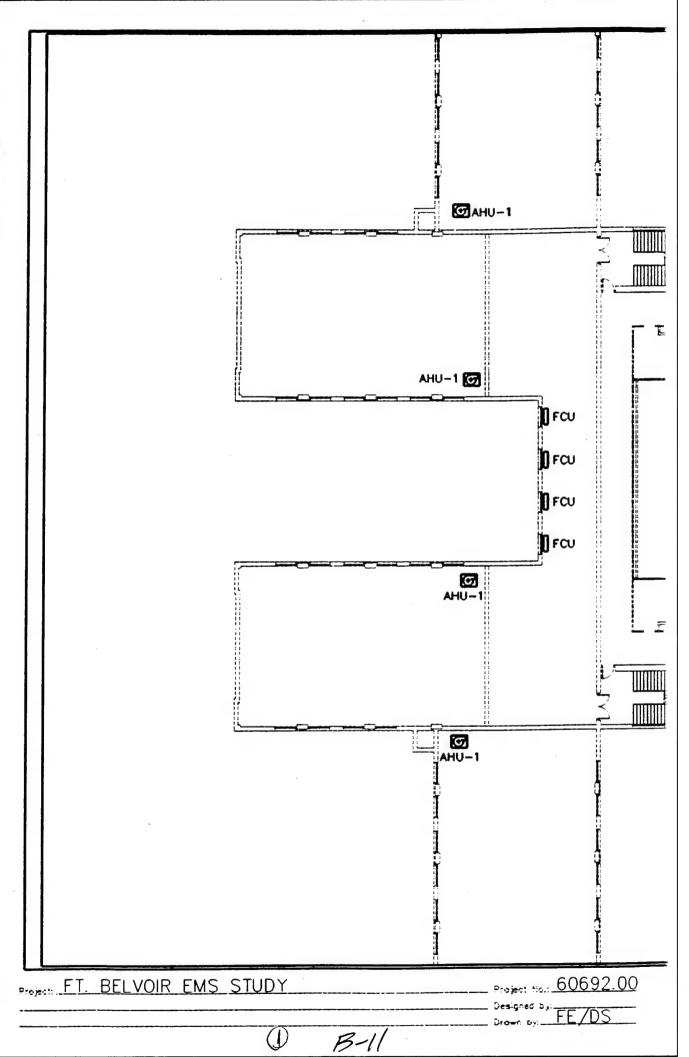
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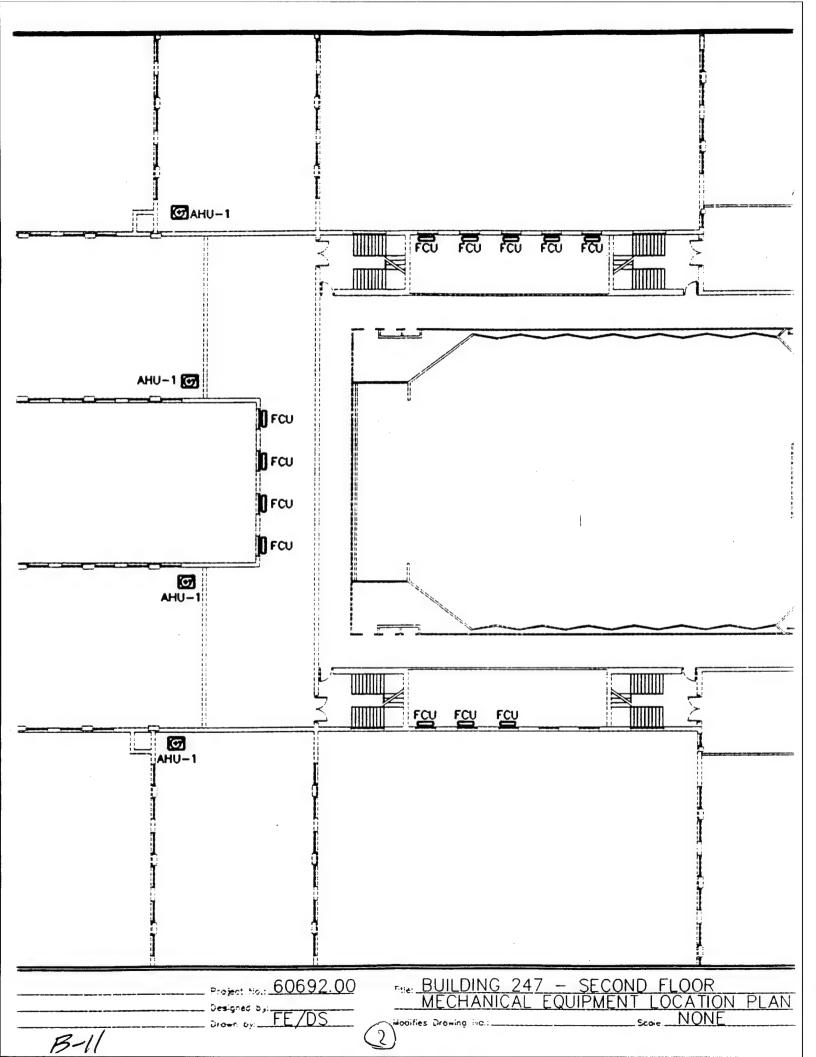
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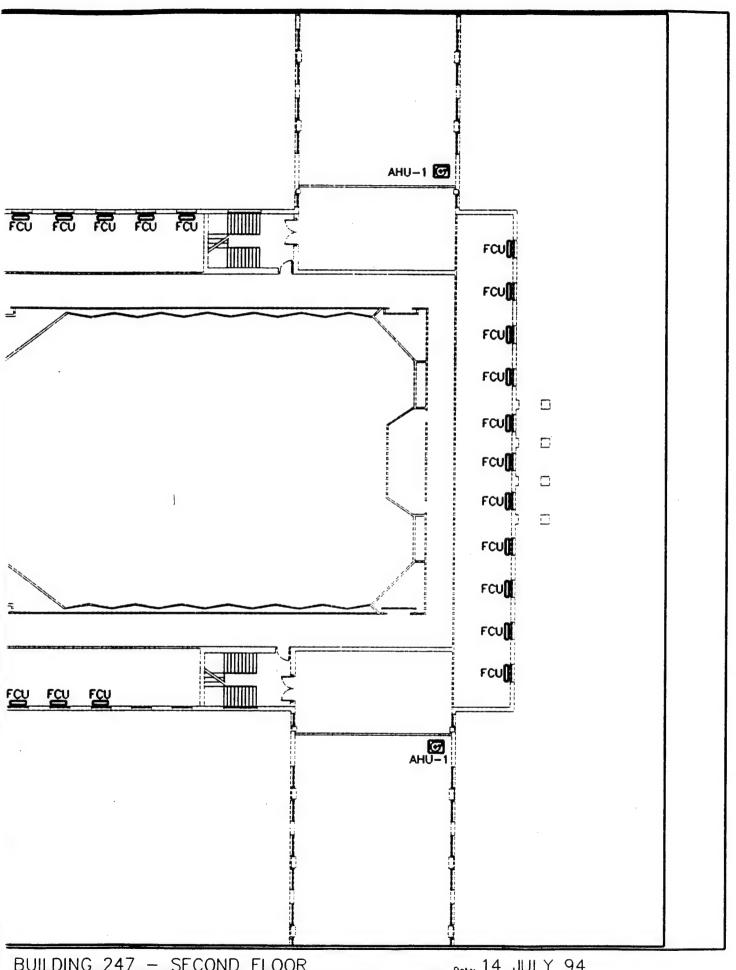


ARCHITECTURE & ENGRIEERING, P.C. THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201–0617 TEL. (518) 463–2141

THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 TEL (202) 471-5000







BUILDING 247 — SECOND FLOOR

MECHANICAL EQUIPMENT LOCATION PLAN

Seet 16.: 3 of: 5

See NONE

Order 14 JULY 94

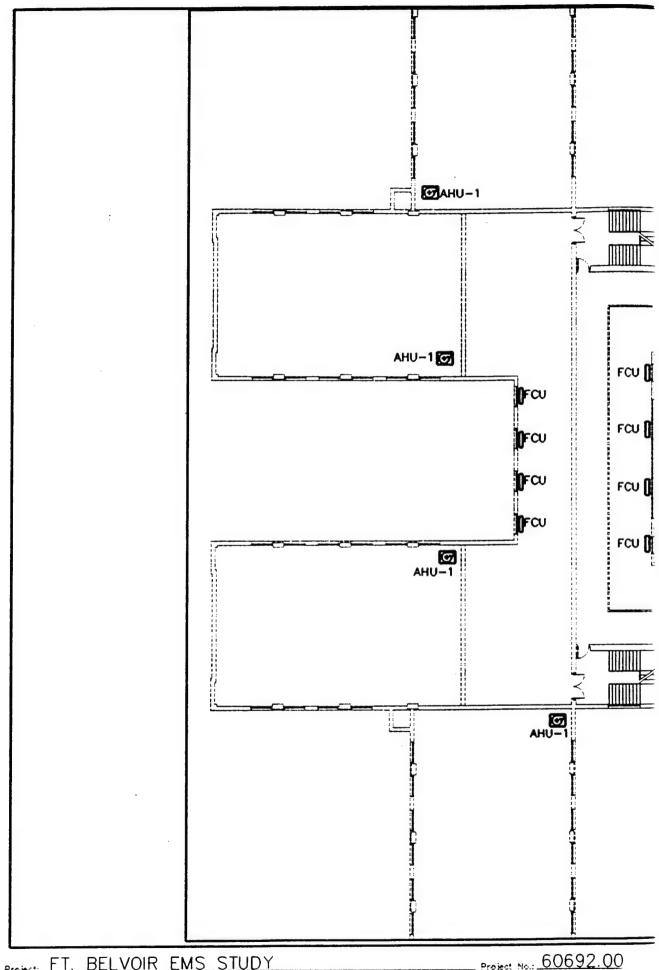
Sheet 16.: 3 of: 5



ARCHITECTURE & ENGINEERING, P.C.

THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL (518) 463-2141

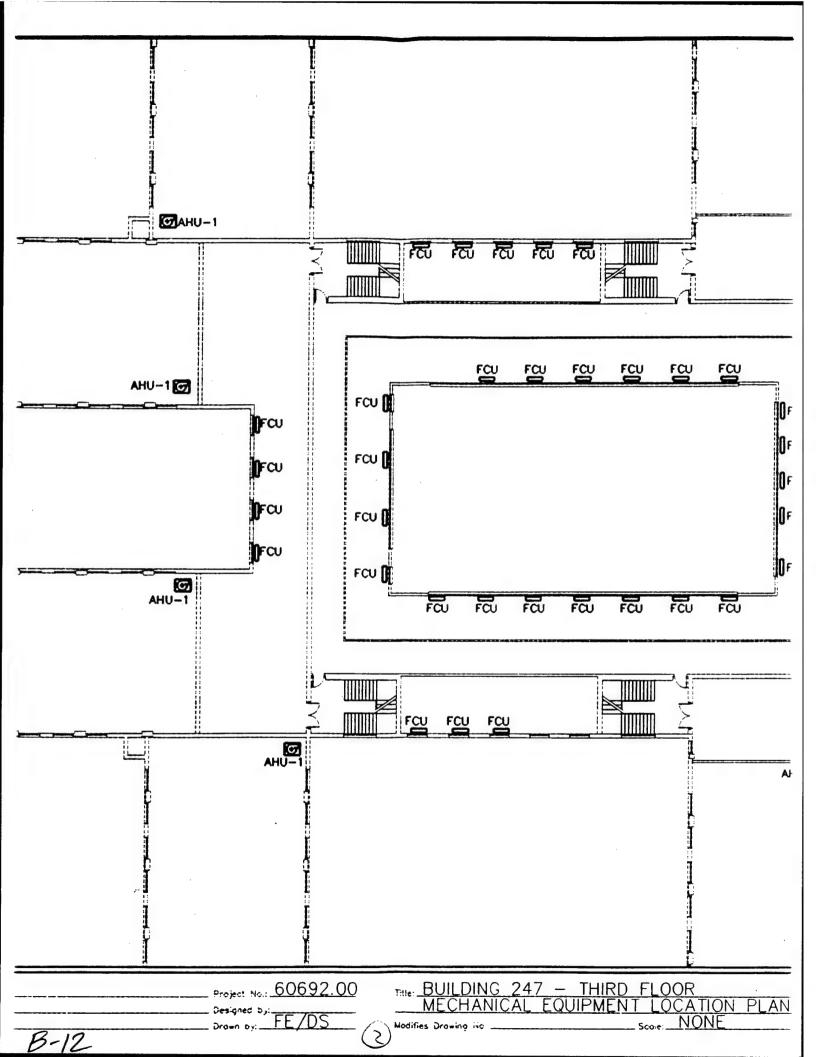
THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 WIL. (202) 471-5000

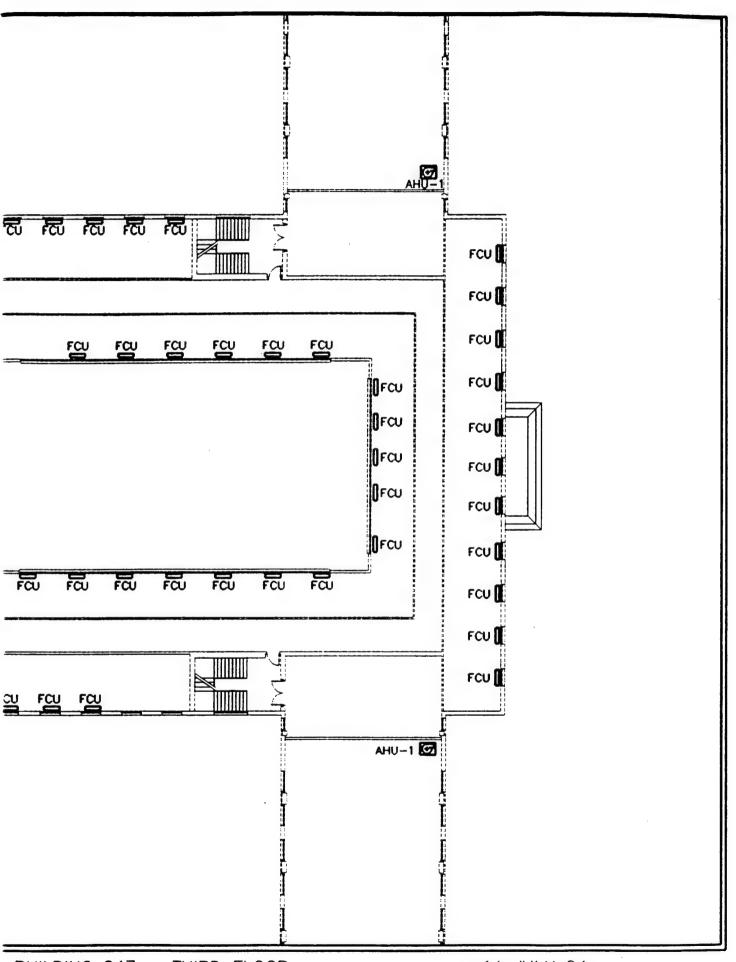


Project: FT. BELVOIR EMS STUDY
Project No.: 60692.00

Designed by:
Drown by: FE/DS

(1) B-12





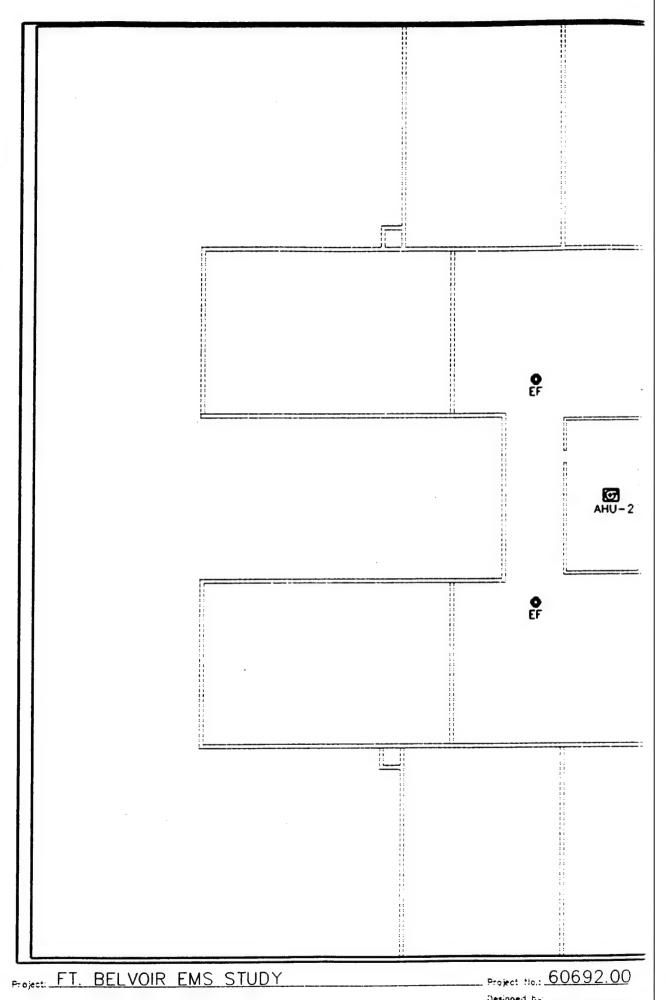
BUILDING 247 - THIRD FLOOR MECHANICAL EQUIPMENT LOCATION PLAN NONE

3

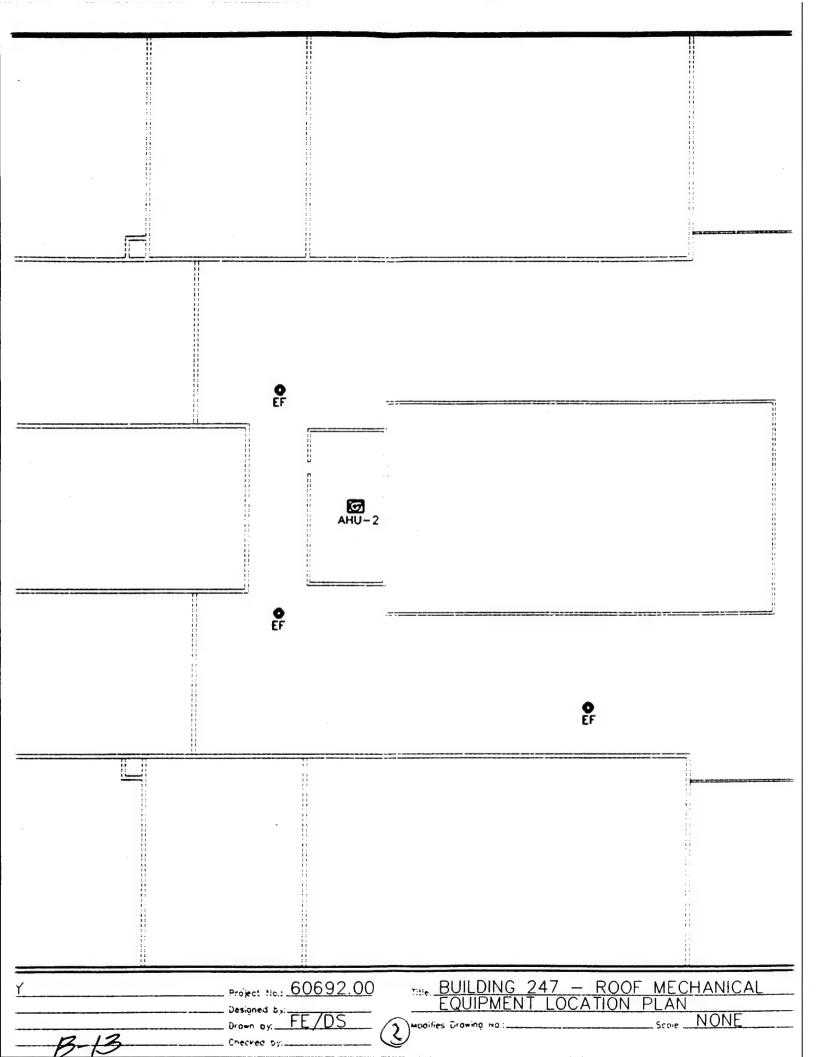


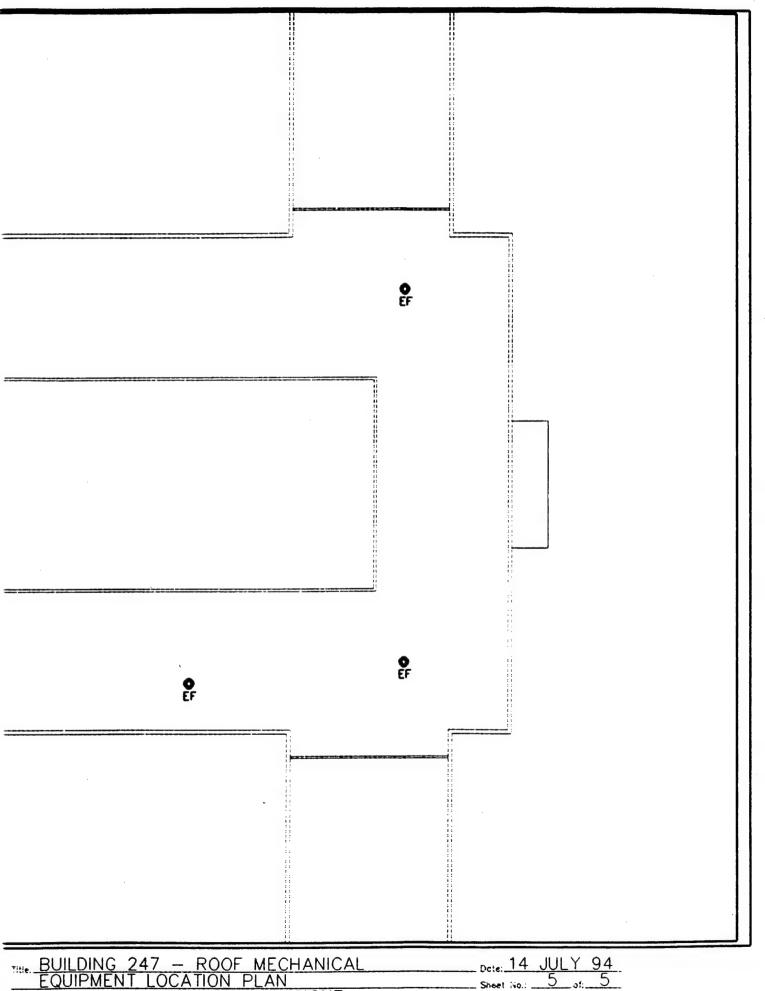
ARCHITECTURE & ENGINEERING, P.C. THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL. (518) 463-2141

THE FLOUR MELL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 TEL. (202) 471-5000









EQUIPMENT LOCATION PLAN

Sheet No.: 5 of: 5

Modifies Drawing No.: Score NONE Drawing No.: 5

BUILDING 1425

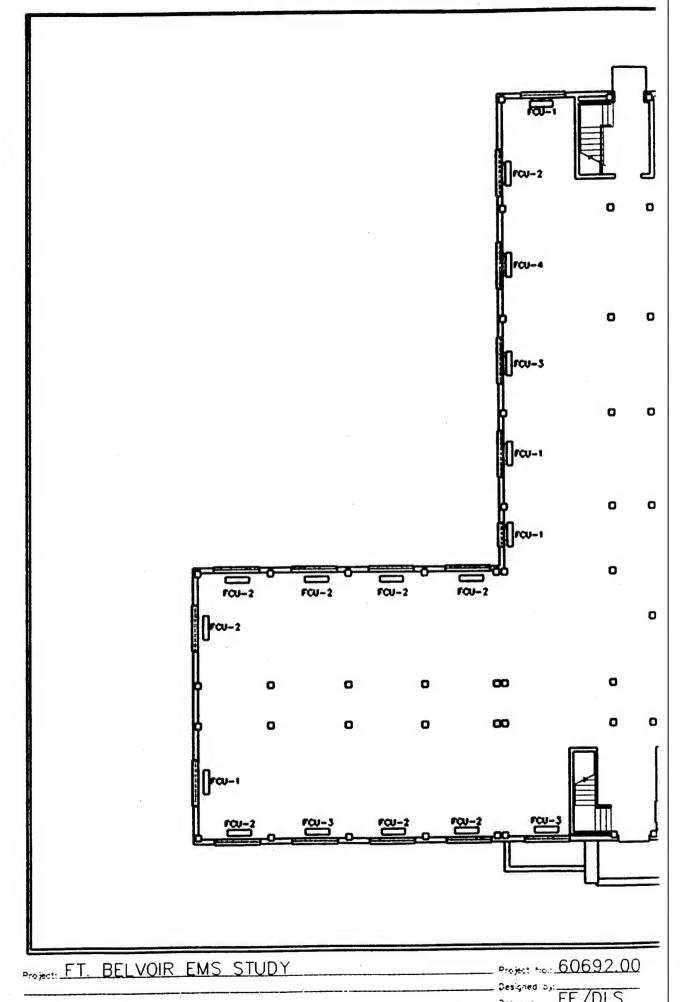
B-14



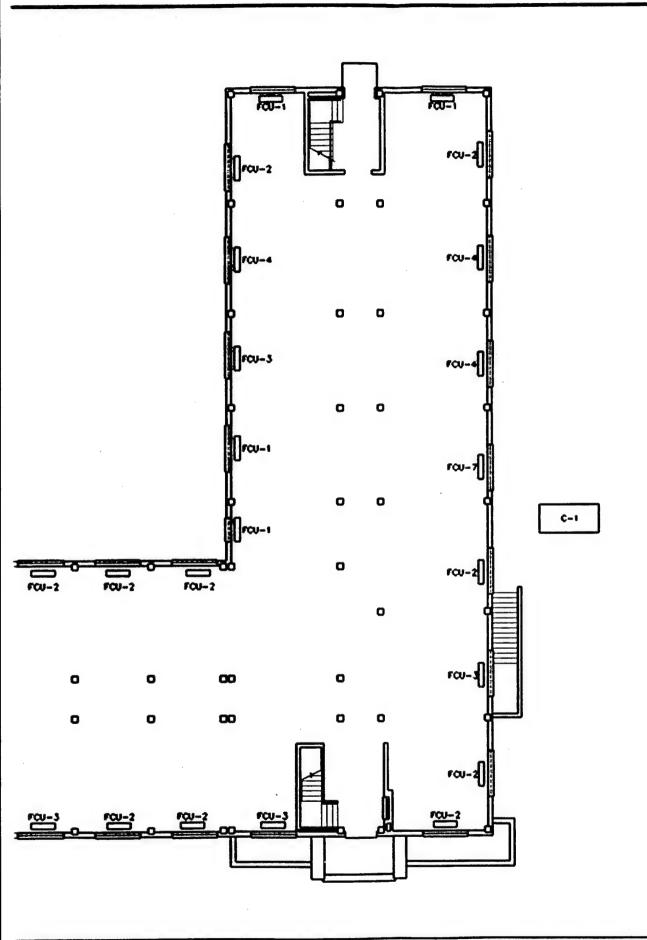
ARCHITECTURE & ENGINEERING, P.C.

THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL (518) 463-2141

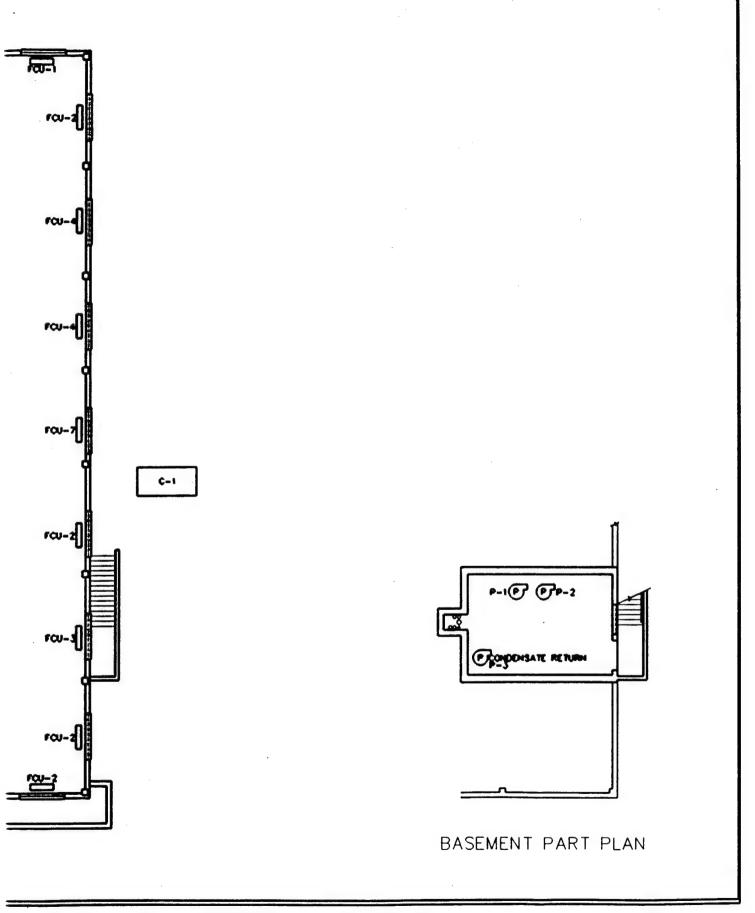
THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 VEL. (202) 471-5000



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3-15

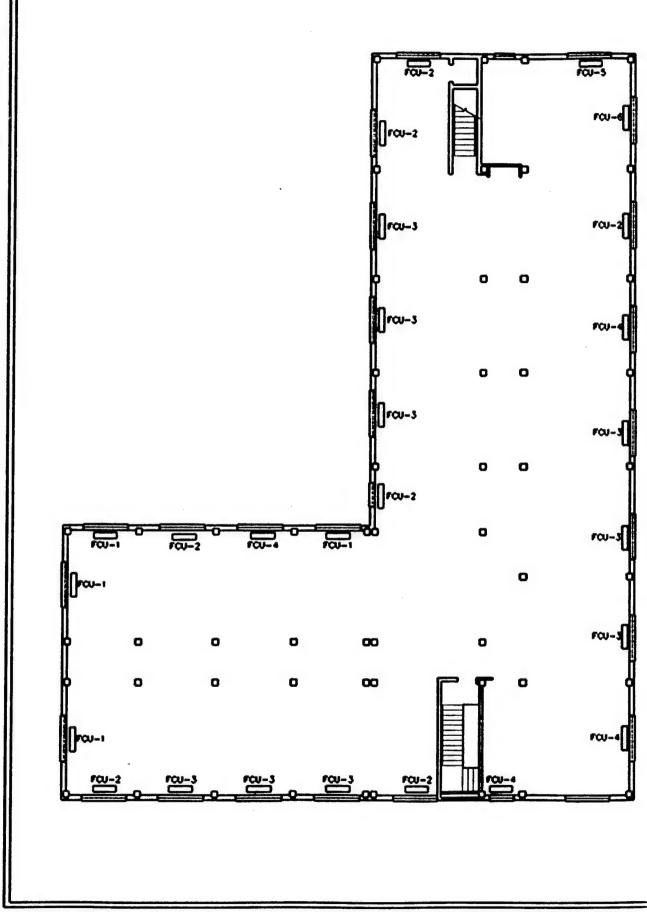




ARCHITECTURE & ENGINEERING, P.C.

BHE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 EL. (518) 463-2141

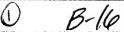
BIE FLOUR MILL 1000 POTOMAC ST., NW MASHINGTON, DC 20007 NO. (202) 471-5000

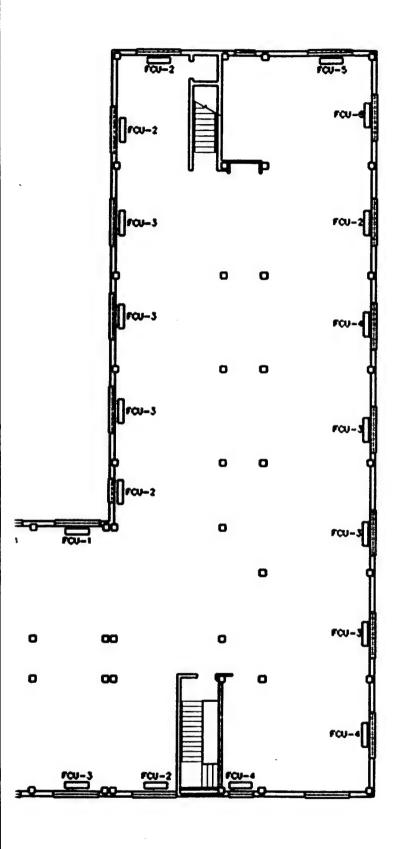


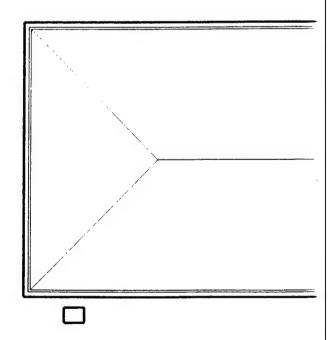
Project: FT. BELVOIR EMS STUDY

Project No : 60692.00

Drown by: FE/DLS



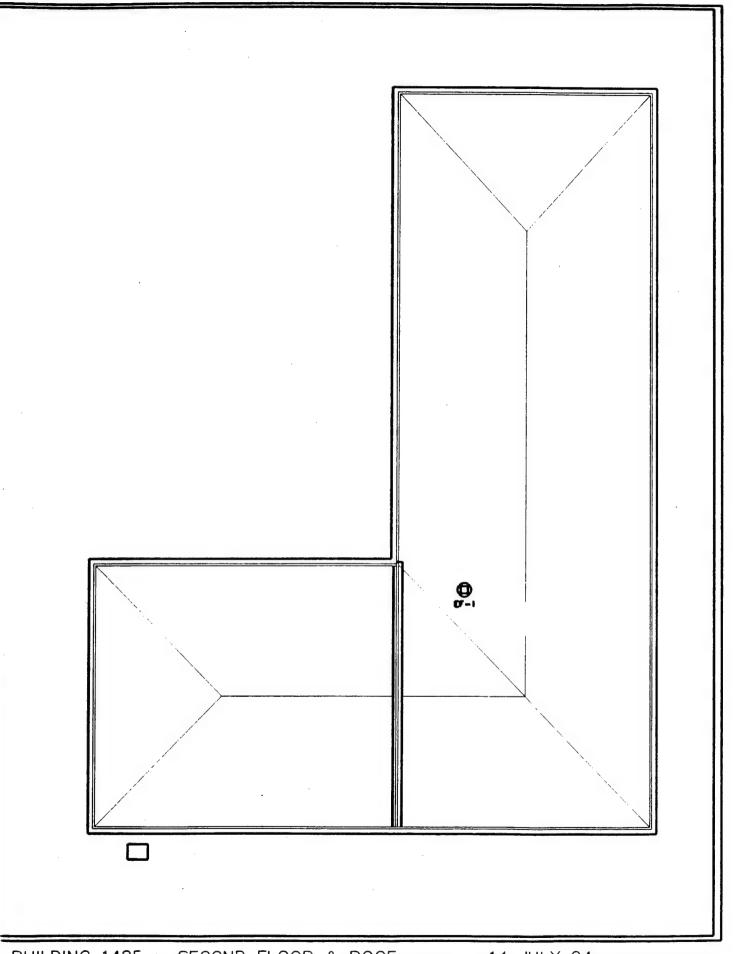




BUILDING 1425 - SECOND FLOOR & ROC MECHANICAL EQUIPMENT LOCATION PLAN

Modifies Drawing inc.: Scale: 1/16" = 1'

B-16



BUILDING 1425 — SECOND FLOOR & ROOF

MECHANICAL EQUIPMENT LOCATION PLAN

Sheet No.: 2 of: 2

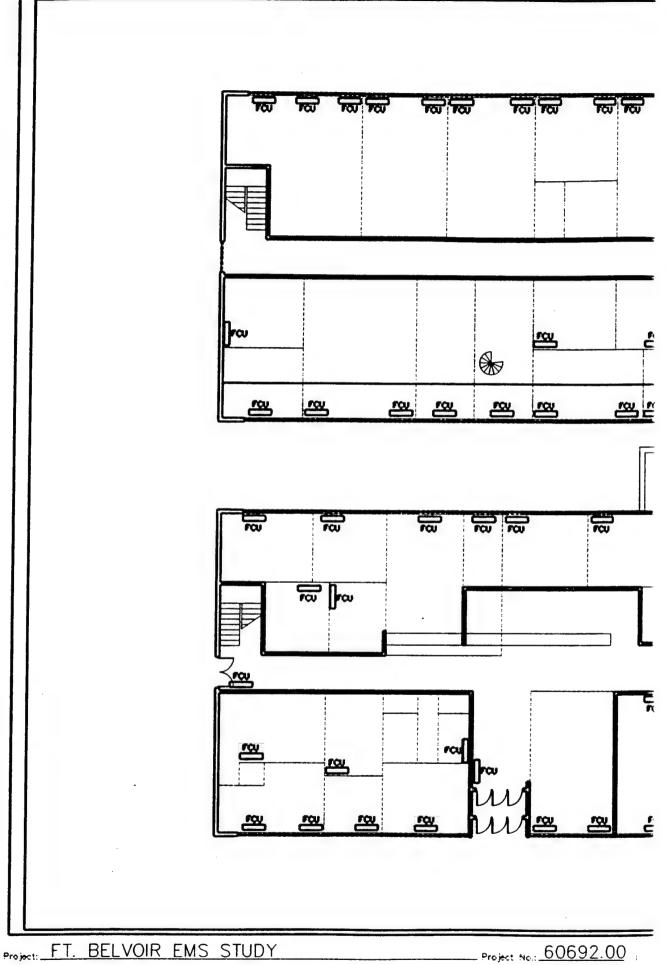
ies Drowing No.: Scoie: 1/16" = 1'-0" Drowing No.:

BUILDING 3136



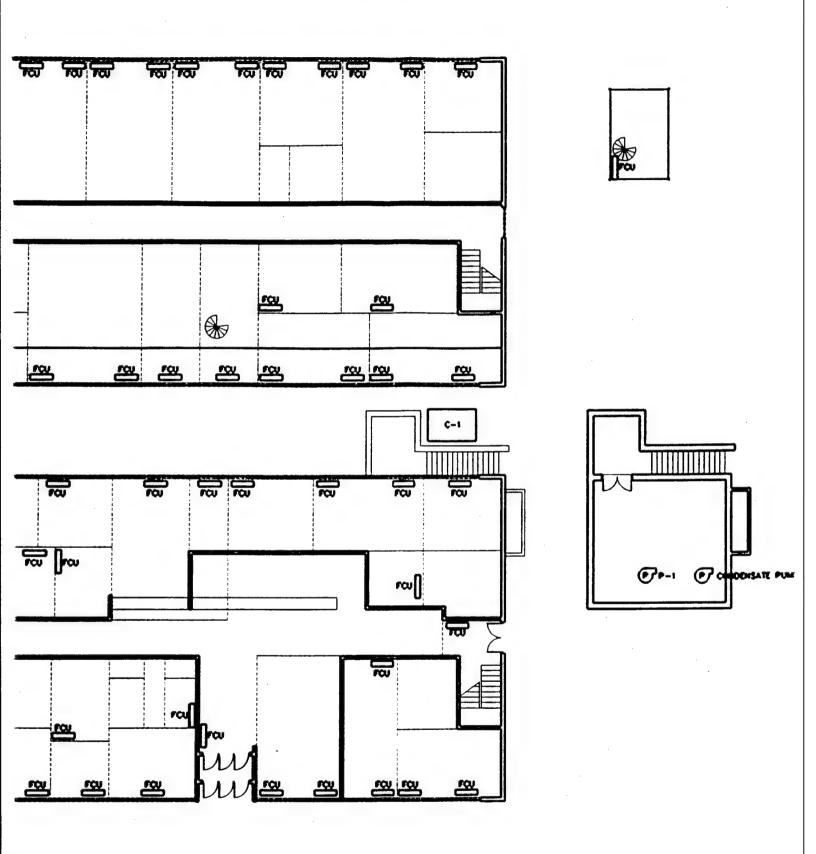
ARCHITECTURE & ENGINEERING, P.C. THE ARGUS BUILDING BROADWAY AT BEAVER POST OFFICE BOX 617 ALBANY, NY 12201-0617 TEL. (518). 463-2141

THE FLOUR MILL 1000 POTOMAC ST., NW WASHINGTON, DC 20007 EL (202) 471-5000



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Project No.: 60692.00

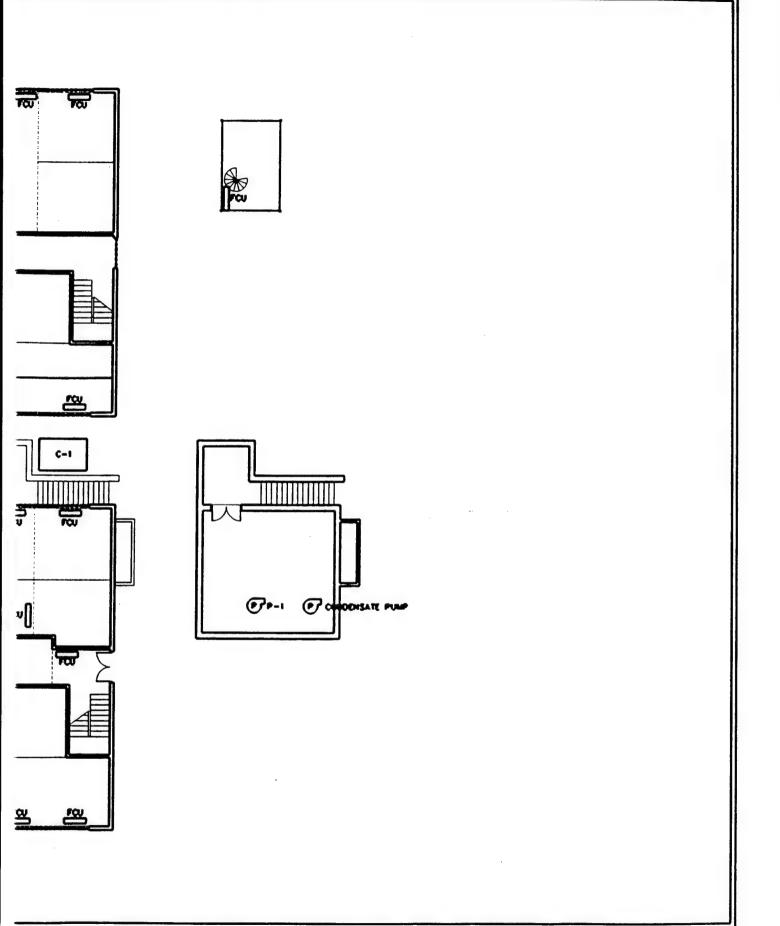
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Drown by FE/DLS

And FIRST AND SECON FLOOR EQUIPMENT LOCATION PLANS

And First Drowing No. Scoie: 1/16" =

-18



(}

APPENDIX C CARRIER E20-II BUILDING SIMULATION INPUT DATA

BUILDING 200

Page 1 of 1 HAP v3.04 *****************

TABLE 1. SIMULATION WEATHER DATA DESIGN PARAMETERS

City	 Washington

Location....: Dist. of Columbia

Type of Data..... Typical Meteorological Year Latitude..... 38.9 deg

Longitude..... 77.0 deg

Elevation....: 14.0 ft

* Average Ground Reflectivity..... 0.20

Local Time Zone (GMT +/- N hours)..... 5.0 hours * Daylight Savings Time Considered....?

* = User-defined design parameters. All other values are fixed.

TABLE 2. DRY-BULB TEMPERATURE STATISTICS (F)

_____ Absolute Average Average Absolute Maximum Maximum Average Minimum Minimum _____ 60.4 39.3 30.7 21.0 62.1 42.8 33.1 22.9 75.5 53.9 43.3 32.4 85.5 65.7 55.0 44.3 91.9 73.3 63.5 53.8 93.5 80.8 70.0 58.8 91.0 84.9 75.9 66.5 96.8 85.1 74.3 64.5 91.6 79.3 69.3 60.0 84.7 67.5 56.8 46.7 -1.9 January 7.5 February 17.1 March 31.2 April 40.5 Mav 48.8 June 55.8 July 49.6 August September 46.5 October 84.7 67.5 56.8 46.7 23.4 75.7 56.4 46.6 35.7 59.0 42.7 36.9 30.9 November 17.3 20.5 December ______

TABLE 3. DAILY TOTAL SOLAR RADIATION STATISTICS

	[Daily Total Solar] (BTU/sqft)			[Daily (Di		
Month	Maximum	Average	Minimum	Maximum	Average	Minimum
January	1043.4	609.1	137.7	0.648	0.430	0.107
February	1448.6	815.5	79.9	0.685	0.433	0.048
March	1861.2	1183.4	211.6	0.680	0.473	0.094
April	2371.0	1484.8	247.6	0.717	0.479	0.079
May	2579.4	1712.0	355.4	0.711	0.487	0.104
June	2551.8	1890.8	515.8	0.697	0.514	0.140
July	2398.3	1714.6	629.5	0.657	0.478	0.171
August	2378.9	1696.2	708.2	0.694	0.522	0.227
September	1943.6	1307.6	258.0	0.674	0.482	0.094
October	1546.1	977.2	92.6	0.656	0.469	0.045
November	1143.4	672.4	129.4	0.647	0.437	0.094
December	803.2	488.0	73.1	0.618	0.382	0.057

Notes: * All solar data is daily total flux on a horizontal surface.

^{*} Clearness number is (Daily Total Solar)/(Extraterrestrial Solar) Values between 0.70 and 0.80 represent clear conditions.

CALENDAR DATA

Prepared By: EINHORN YAFFEE PRESCOTT	12-30-94
HAP v3.04	Page 1 of 1
**********	**********
Calendar Name: Sample Calendar	Day Type Assignments
	Monday = Weekday
January first is on: Friday	Tuesday = Weekday
	Wednesday = Weekday
Day Type Names	Thursday = Weekday
Day Type 1 = Weekday	Friday = Weekday
Day Type 2 = Saturday	Saturday = Saturday
Day Type 3 = Sunday	Sunday = Sunday
	Holiday = Sunday
Holidays	
(No holidays specified)	

SCHEDULE DATA

Prepared By: HAP v3.04 *******						****	****	****	****	Page		f 1
Schedule Name: Assembly Spaces Hourly Percentages												
Hour>	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY Weekday Saturday Sunday	0 0 0	0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 0 0	10 10 0 0	25 25 0 0	50 25 0 0	75 25 10 10	100 30 25 25
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY Weekday Saturday Sunday ************************************	100 40 25 25	100 40 40 40	100 40 40 40	100 30 30 30	100 25 25 25	100 25 25 25	100 25 25 25	100 25 25 10	100 25 25 0	100 25 25 0	75 20 10 0	100 10 0 0
Schedule Name	: Peo	ple					Hou	rly P	ercen	tages		
Hour>	00	01	02	03	04	05	06 	07	08	09	10	11
DESIGN DAY Weekday Saturday Sunday	0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	10 10 0 0	25 25 0	50 50 0	75 75 10 10	100 100 25 25
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY Weekday Saturday Sunday *******			100 100 50 100	100 100 75 100	100 100 100 100 *****	100 100 100 100 *****						10 10 75 0
Schedule Name	: Lig	hts 					Hou 	rly P	ercen	tages		
Hour>	00	01	02	03	04	05	06 	07	80	09	10	11
DESIGN DAY Weekday Saturday Sunday	25 25 25 25	25 25 25 25	25 25 25 25	25 25 25 25	25 25 25 25	25 25 25 25	25 25 25 25 25	100 100 25 25	100 100 25 25	100 100 25 25	100 100 25 100	100 100 25 100
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY Weekday Saturday Sunday ***********	100 100 100 100 *****	100 100 100 100 100	100 100 100 100 *****	100 100 100 100	100 100 100 100	100 100 100 100	100 100 100 100	100 100 100 100	100 100 100 25 ****	100 100 100 25 *****	100 100 100 25 ****	100 100 100 25

WALL CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE HAP v3.04		*****	*****		2-30-94 Page 1 *****
WALL TYPE 1: (CUSTOM WALL)					
Description Brice Absorptivity 0.90					
Layer Description	Thickness	Density	Spec.Ht	R-Val	Weight
Inside surface resistance 6in LW concrete block Vermiculite Insulation Airspace 4-in (102 mm) face brick Outside surface resistance	1.00	19.0 6.0 0.0 125.0	0.00	6.45 0.91	1.5
Totals	14.00			10.46	52.7
Thickness: in R-value : (hr-sqft-F)/BTU	Density: lb/cu Specific Heat:		_	nt: lb/	sqft

ROOF CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94 HAP v3.04 Page 1 ************************** ROOF TYPE 1: (PRE-DEFINED ROOF) Group.....: BUILT-UP ROOF ON STEEL OR WOOD Type.....: Built-up roof + R-7 board + steel deck Description...: Pre-Defined Roof U-value....: 0.121 BTU/hr/sqft/F Color....: Dark _____ Roof Construction (Inside to Outside): 22 gage steel deck R-7 (RSI-1.2) board insulation Built-up roofing

WINDOW TYPE CONSTRUCTIONS

HAP v3.04	Prepared by: EINHORN YAFFEE PRESCOTT 12-30-9 HAP v3.04 Page ************************************						
WINDOW TYPE 1: (P	RE-DEFINED WINI	·					
Glass Group: SINGLE PANE, CLEAR Glass Type: 1/4" clear Window Description: Pre-Defined Window Height: 1.00 ft Width: 1.00 ft Frame Type: Aluminum with thermal breaks Interior Shade Type: No Shades Used Overall U-value: 1.077 BTU/hr/sqft/F Overall Shade Coeff: 0.871							
	Predefi	ined Glass Data					
Transmissivity	Reflectivity 0.079	0.129	U-Value 1.090	Coefficient 0.960			
WINDOW TYPE 2: (P							
Glass Group Glass Type Window Description Height Width Frame Type Interior Shade Typ Overall U-value Overall Shade Coef	: SINGLE I: 1/8" cl: Pre-Defi: 1.00: Aluminur e: No Shade: 1.094 f: 0.903	PANE, CLEAR lear ined Window ft ft n with thermal br es Used					
Glass Transmissivity 0.841	Predefi Glass Reflectivity	ined Glass Data Glass Absorptivity 0.081	U-Value	Coefficient			

ELECTRIC RATE DATA

Prepared by: E	INHORN YAFFEE PRESCOTT	12-30-94
HAP v3.04		Page 1
*****	**************	******
BASIC ELECTRIC	RATE INFORMATION	
ELECTRIC RATE INFORMATION:	Rate schedule name: Ft. Belvoir Equivalent Currency symbol	

FUEL RATE DATA

Prepared by: EI HAP v3.04	NHORN YAFFEE PRESCOTT	12-30-94 Page 1
*****	************	*********
BASIC FUEL RATE	INFORMATION	
FUEL RATE INFORMATION:	Rate schedule name: Ft. Currency symbol: Units of measurement: Fuel conversion factor: Type of rate schedule:	\$ 1000 lb 1000.00000 kBTU/1000 lb
	Flat rate:	-

FUEL RATE DATA

HAP v3.04	NHORN YAFFEE PRESCOTT	12-30-94 Page 1
*****	*************	******
BASIC FUEL RATE	INFORMATION	
FUEL RATE INFORMATION:	Rate schedule name: Washington Gas F Currency symbol: \$	Rate Schedule 2
	Units of measurement Therm	
	Fuel conversion factor: 100.00000	kBTU/Therm
	Type of rate schedule Simple	
	Flat rate 0.60790	\$/Therm

Prepared by: EINHOLHAP v3.04	RN YAFFEE	PRESCOTT				12-30-94 Page 1
******	******	*****	*****	*****	******	-
GENERAL			SCHEDULE			
Name: AHU-1			l Lightin			
Floor Area:		sqft		ghts.: Lig	ghts	
Building Weight.:	70.0	lb/sqft	People.	: Ass	sembly Sp	aces
Windows Shaded?	N		Equipmen	nt: Ped	ople	
Partitions Used.?	Y		Misc. S	ens: Ped	ople	
LIGHTING			Misc. L	atent: Peo	ople	
Overhead Fixture:	Recessed		INFILTRA'		-	
Lamp Wattage:	3.00	W/sqft	Cooling	:	0.00 C	FM/saft
Ballast Mult:		-	Heating			
Task Lighting:		W/sqft	Typical		0.00 C 0.00 C	FM/saft
PEOPLE		_	When Far		N	in bqic
Occupancy:		caft/ne		011	14	
Activity Level:				:Sla	o On Grad	•
Sensible:				er		100.0 ft
Latent:		BTU/hr		oor Area.		80.0 sqft
OTHER LOADS	205.0	B10/111		-Value		_
+	0.00	W/acft		ion R-valu		2.40
Equipment:			Insurac	IOII K-Vali	ue:	0.00
Misc. Sensible:		BTU/hr				
Misc. Latent:						
WALL Gross Area		WIN		WIN		Any
Exp (sqft)	1			1		
HAP (BQIC)						
N 384.0		1	0 -	1	0 -	N
E 783.0	i 1 i	1 2	40 -	1	0 -	N
:	=======		=======	========		
ROOF Slope Gros	ss Area	ROOF	SKYLIGHT	1		
Exp (deg)	(sqft)	Type T	ype Qty			
HOR -	1728.0	1	1 0			
		=======				
PARTITION LOADS	T	ype 1		Туре	e 2	
Type				Ceiling		
Area	:	286.0 sq	ft	(0.0 sqft	
U-value			U/hr/sqft/			r/sqft/F
Maximum Space Temp		95.0 F			5.0 F	
Outside Air Temp @		95.0 F			5.0 F	
Minimum Space Temp		0.0 F			5.0 F	
Outside Air Temp @	Min:	0.0 F		54	4.0 F	
			=======	=======		

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Prepared by: EINHORN YAFFEE	PRESCOTT 12-30-94
HAP v3.04	Page 1
HAP v3.04 ***********************************	Page 1 ***********************************
Activity Level: Sedentary Sensible: 280.0 Latent: 270.0 OTHER LOADS Equipment: 0.00 Misc. Sensible: 0.0	Work Type:Slab On Grade BTU/hr Perimeter: 130.0 ft BTU/hr Slab Floor Area: 2376.0 sqft Floor R-Value: 2.40
mise. Latent 0.0	·
WALL Gross Area WALL Exp (sqft) Type	WINDOW WINDOW Any Type Qty Shade Type Qty Shade Doors?
	1 75 - 1 0 - N
ROOF Slope Gross Area	ROOF SKYLIGHT Type Type Qty
HOR - 2376.0	- 1 - 1
No partition data for this s	======================================

Prepared by: EINHORN	YAFFEE	PRESCO	TT					12-30-94
HAP v3.04								Page 1
******	*****	*****	****	*****	*****	****	*****	******
GENERAL			_	CHEDULE	_			
Name: AHU 2-2	Stage			Lighting	g:	Lights	5	
Floor Area:	1620.0	sqft		Task Lig	ghts.:	Lights	3	
Building Weight.:	70.0	lb/sq	[ft	People.	:	Assemb	oly Spa	ces
Windows Shaded?	N			Equipmen	nt:	People	9	
Partitions Used.?	И			Misc. Se	ens:	People	9	
LIGHTING				Misc. La	atent:	People	9	
Overhead Fixture: Re	ecessed		I	NFILTRA'	TION			
Lamp Wattage:	5.00	W/sqf	t	Cooling	:	(0.00 CF	M/sqft
Ballast Mult:	1.00			Heating	:	(0.00 CF	M/sqft
Task Lighting:	0.00	W/sqf	t	Typical	:	(0.00 CF	M/sqft
PEOPLE				When Far	n On.?		N	-
Occupancy:	40.0	sqft/	per F	LOOR				
Activity Level: Me				Type	:S	lab Or	n Grade	
Sensible:	295.0	BTU/h		Perimete				130.0 ft
Latent:	455.0	BTU/h	r	Slab Flo	oor Are	a	:	1620.0 sqft
OTHER LOADS				Floor R	-Value.		:	2.40
Equipment:	0.00	W/sqf	t	Insulat:	ion R-v	alue.	:	0.00
Misc. Sensible:	0.0	BTU/h	r					
Misc. Latent:	0.0	BTU/h	r					
				======		=====	======	========
WALL Gross Area	WALL	W	INDOW		W	INDOW		Any
Exp (sqft)	Type	Type	Qty	Shade	Type	Qty	Shade	Doors?
W 360.0	1	1	-		1	0	-	N
N 864.0	_	1	-		1	0	-	N
					====== '	=====		========
	Area		!					
Exp (deg) (sqft)	Type	Liàbe	Qty	 			
HOR - 10	520.0	1	1 1	0	<u> </u> 			
nor - 10		_	, –	_	 =====	====		========
No partition data for								

Prepared by: EINHORN YAFFEE	PRESCO'	TT					12-30-94
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*******	*****	****	*****	*****	****	*****	*****
GENERAL		S	CHEDULES				
Name: AHU 2-3 Multi-	Purpose		Lighting	J:	Light	s	
Floor Area: 2135.	0 sqft		Task Lig	ghts.:	Light	s	
Building Weight.: 70.	0 lb/sq	ft	People.				ces
Windows Shaded?	N		Equipmen	nt:	Peopl	е	
Partitions Used.?	N		Misc. Se	ens:	Peopl	е	
LIGHTING			Misc. La	atent:	Peopl	e	
Overhead Fixture: Recessed		1	NFILTRA	TION			
Lamp Wattage: 3.6	0 W/sqf	t	Cooling	:		0.00 CF	M/sqft
Ballast Mult: 1.0	0		Heating	:		0.00 CF	M/sqft
Task Lighting: 0.0	0 W/sqf	t	Typical	:		0.00 CF	M/sqft
PEOPLE			When Far			N	
Occupancy: 40.	0 sqft/	per E	FLOOR				
Activity Level: Sedentar	-	-	Type	:S	lab O	n Grade	
-	o BTU/h	r	Perimete				140.0 ft
Latent: 270.	O BTU/h	r	Slab Flo	or Are	a	:	2135.0 sqft
OTHER LOADS			Floor R	-Value.		:	2.40
Equipment: 0.0	0 W/sqf	t	Insulat:	ion R-v	alue.	:	0.00
	o BTU/h						
	o BTU/h						
=======================================			======		=====	======	
WALL Gross Area WALL	l W	INDOV	1	W	INDOW	•	Any
Exp (sqft) Type	Type	Qty	Shade	Туре	Qty	Shade	Doors?
							·
E 480.0 1	1	20	_	1	0	-	N
S 286.0 1	1	96	-	1	0	_	N
SE 420.0 1	1	0	_	1	0	-	N
	======	====			=====	======	
ROOF Slope Gross Area	ROOF	SKY	LIGHT				
-	Туре	Туре	e Qty	į			
HOR - 2135.0	1		L 0				
=======================================		====	======			======	========
No partition data for this	space.						

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Prepared by: EINHORN YAFFEE PR			12-30-94 Page 1
********	*******	*******	*****
GENERAL	SCHEDULES	5	
Name: AHU 3 Concourse	Lighting	J: Lights	
Floor Area: 4500.0 s	sqft Task Lig	ghts.: Lights	
Building Weight.: 70.0 l	lb/sqft People	: People	
Windows Shaded? N	Equipmer	nt: People	
Partitions Used.? N	Misc. Se	ens: People	
LIGHTING	Misc. La	atent: People	
Overhead Fixture: Recessed	INFILTRAT	TION	
Lamp Wattage: 2.00 W	N/sqft Cooling.	: 0.00 CFM	/sqft
Ballast Mult: 1.00	Heating.	: 0.00 CFM	-
Task Lighting: 0.00 W			
PEOPLE	When Far		. 1
Occupancy: 225.0 s	sqft/per FLOOR		
Activity Level : Office Work		:Slab On Grade	
Sensible 245.0 B		er:	80.0 ft
Latent 205.0 B	STU/hr Slab Flo	oor Area:	4500.0 sqft
OTHER LOADS	Floor R-	-Value:	2.40
Equipment: 0.00 W	N/sqft Insulati	on R-value:	0.00
Misc. Sensible: 0.0 B	BTU/hr		
Misc. Latent: 0.0 B	BTU/hr		
	.============		========
WALL Gross Area WALL	WINDOW	WINDOW	Any
Exp (sqft) Type T	Type Qty Shade	Type Qty Shade	Doors?
S 960.0 1	1 765 -	1 0 -	N
N 620.0 1	1 510 -	1 0 -	N
=======================================			========
ROOF Slope Gross Area R	ROOF SKYLIGHT		
Exp (deg) (sqft) T	Type Type Qty		
HOR - 2313.0	1 2 540		
		. = = = = = = = = = = = = = = = = = =	========
No partition data for this spa	ace.		
			=======

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94 Page 1					
*************	**************					
GENERAL	SCHEDULES					
Name: AHU 4-1 Music Room	Lighting: Lights					
Floor Area: 340.0 sqft	Task Lights : Lights					
Building Weight.: 70.0 lb/sqft	_					
Windows Shaded? N	Equipment: People					
Partitions Used.? N	Misc. Sens: People					
LIGHTING	Misc. Latent: People					
Overhead Fixture: Recessed	INFILTRATION					
Lamp Wattage: 3.00 W/sqft	Cooling: 0.00 CFM/sqft					
Ballast Mult: 1.00	Heating: 0.00 CFM/sqft					
Task Lighting: 0.00 W/sqft	Typical: 0.00 CFM/sqft					
PEOPLE	When Fan On.?					
Occupancy: 170.0 sqft/per						
Activity Level: Office Work	Type:Slab On Grade					
Sensible: 245.0 BTU/hr	Perimeter 0.0 ft					
Latent 205.0 BTU/hr	Slab Floor Area: 340.0 sqft					
OTHER LOADS	Floor R-Value 2.40					
Equipment: 0.00 W/sqft	Insulation R-value: 0.00					
Misc. Sensible: 0.0 BTU/hr						
Misc. Latent: 0.0 BTU/hr						
No external wall or window data for this space.						
ROOF Slope Gross Area ROOF Sk	CYLIGHT					
Exp (deg) (sqft) Type Typ	pe Qty					
HOR - 340.0 1	2 0					
=======================================						
No partition data for this space.						

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94
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*********	***********
GENERAL	SCHEDULES
Name: AHU 4-2 TV Room	Lighting: Lights
Floor Area: 578.0 sqft	Task Lights.: Lights
Building Weight.: 70.0 lb/sqft	People: People
Windows Shaded? N	Equipment: People
Partitions Used.? N	Misc. Sens: People
LIGHTING	Misc. Latent: People
Overhead Fixture: Recessed	INFILTRATION
Lamp Wattage: 2.10 W/sqft	Cooling: 0.00 CFM/sqft
Ballast Mult: 1.00	Heating: 0.00 CFM/sqft
Task Lighting: 0.00 W/sqft	- · · · · · · · · · · · · · · · · · · ·
PEOPLE	When Fan On.?
Occupancy: 144.0 sqft/per	FLOOR
Activity Level: Seated at Rest	Type:Slab On Grade
Sensible: 230.0 BTU/hr	Perimeter 0.0 ft
Latent 120.0 BTU/hr	Slab Floor Area: 578.0 sqft
OTHER LOADS	Floor R-Value 2.40
Equipment: 0.00 W/sqft	
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
No external wall or window data for t	_
ROOF Slope Gross Area ROOF S	· ·
Exp (deg) (sqft) Type Ty	pe Qty
HOR - 578.0 1	2 0
No partition data for this space.	

Prepared by: EINHORN YAFFEE PRESCOT HAP v3.04	T 12-30-94 Page 1
*********	**************
GENERAL	SCHEDULES
Name: AHU 4-3 Mini Auditoriu	
Floor Area: 250.0 sqft	Task Lights.: Lights
Building Weight: 70.0 lb/sqf	
	_
	Equipment: People
Partitions Used.? N	Misc. Sens: People
LIGHTING	Misc. Latent: People
Overhead Fixture: Recessed	INFILTRATION
Lamp Wattage: 4.20 W/sqft	_
Ballast Mult: 1.00	Heating: 0.00 CFM/sqft
Task Lighting: 0.00 W/sqft	Typical: 0.00 CFM/sqft
PEOPLE	When Fan On.?
Occupancy: 50.0 sqft/p	er FLOOR
Activity Level: Seated at Rest	Type:Slab On Grade
Sensible: 230.0 BTU/hr	
Latent 120.0 BTU/hr	Slab Floor Area: 250.0 sqft
OTHER LOADS	Floor R-Value 2.40
Equipment: 0.00 W/sqft	
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
,	
No external wall or window data for	
NO excelled wall of window data for	chis space.
ROOF Slope Gross Area ROOF	SKYLIGHT
Exp (deg) (sqft) Type	
Exp (deg) (sqrc) Type	
HOR - 250.0 1	2 0
No partition data for this space.	

Prepared by: EINHORN YAR	FEE PRESCOT	T			12-30-9	4
HAP v3.04						1
******	*****			*****	*******	*
GENERAL		SCHEDULE				
Name: AHU 4-4 Cra			g: Lights			
Floor Area: 4			ghts.: Lights			
Building Weight.:	70.0 lb/sqft	t People.	: People	9		
Windows Shaded?	N	Equipme	nt: People	9		
Partitions Used.?	N	Misc. S	ens: People	9		
LIGHTING		Misc. L	atent: People	9		
Overhead Fixture: Reces	sed	INFILTRA	TION			
Lamp Wattage:	3.00 W/sqft	Cooling	:	0.00 CFN	1/sqft	
Ballast Mult:	1.00	Heating	:	0.00 CFN	1/sqft	
Task Lighting:	0.00 W/sqft	Typical	:	0.00 CFN	1/sqft	
PEOPLE		When Fa	n On.?	N		
Occupancy:	50.0 sqft/pe	er FLOOR				
Activity Level: Seate	d at Rest	Type	:Slab Or	n Grade		
Sensible 2	30.0 BTU/hr	Perimet	er	:	0.0 ft	
Latent 1	.20.0 BTU/hr		oor Area		480.0 sqf	t
OTHER LOADS		Floor R	-Value	:	2.40	
Equipment:	0.00 W/sqft	Insulat	ion R-value.	:	0.00	
Misc. Sensible:	0.0 BTU/hr	•				
Misc. Latent:	0.0 BTU/hr	:				
	=======================================	========		======		=
WALL Gross Area WAI			WINDOW		Any	
Exp (sqft) Typ	e Type (Qty Shade	Type Qty	Shade	Doors?	
						-
W 528.0	1 1	0 -	1 0	-	N	
ROOF Slope Gross Are		SKYLIGHT		======		=
-	:) Type					
_			İ			
HOR - 480.	0 1	2 0	1			
	:========	========	========	======		=
No partition data for the	-					

Prepared by: EINHORN YAFFEE PRESCOTT HAP v3.04 ************************************	12-30-94 Page 1
GENERAL SCHEDULES	
Name: AHU 4-5 Reading Room Lighting: Lights Floor Area: 504.0 sqft Task Lights: Lights Building Weight: 70.0 lb/sqft People: People Windows Shaded? N Equipment: People Partitions Used.? N Misc. Sens: People	
LIGHTING Misc. Latent: People	
Overhead Fixture: Recessed INFILTRATION	
Lamp Wattage: 2.40 W/sqft Cooling: 0.00 CFM	-
Ballast Mult: 1.00 Heating: 0.00 CFM	_
Task Lighting: 0.00 W/sqft Typical: 0.00 CFM	i/sqft
PEOPLE When Fan On.? N	
Occupancy: 100.0 sqft/per FLOOR	
Activity Level: Seated at Rest Type:Slab On Grade	
Sensible: 230.0 BTU/hr Perimeter:	0.0 ft
Latent 120.0 BTU/hr Slab Floor Area:	504.0 sqft
OTHER LOADS Floor R-Value:	2.40
Equipment: 0.00 W/sqft Insulation R-value:	0.00
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
WALL Gross Area WALL WINDOW WINDOW	~=====================================
	Any Doors?
Exp (sqrc) Type Type Qcy Shade Type Qcy Shade	DOOLS:
S 288.0 1 1 144 - 1 0 -	N
ROOF Slope Gross Area ROOF SKYLIGHT	
Exp (deg) (sqft) Type Type Qty	
HOR - 504.0 1 2 0	
No partition data for this space.	
no partition data for this space.	

Prepared by: EINHORN YAFFEE PRESCOTT HAP v3.04 ***********************************	12-30-94 Page 1 *****
GENERAL Name: AHU 4-6 Office Floor Area: 588.0 sqft Building Weight: 70.0 lb/sqft Windows Shaded? Partitions Used.? N SCHEDULES Lights Task Lights: Lights People: People Equipment: People Misc. Sens: People	
LIGHTING Overhead Fixture: Recessed Lamp Wattage: 2.00 W/sqft Ballast Mult: 1.00 Task Lighting: 0.00 W/sqft PEOPLE Misc. Latent: People INFILTRATION Cooling: 0.00 CFM/s Heating: 0.00 CFM/s Typical: 0.00 CFM/s When Fan On.? N	sqft
Latent: 205.0 BTU/hr Slab Floor Area: 5 OTHER LOADS Floor R-Value:	28.0 ft 588.0 sqft 2.40 0.00
	Any Doors?
S 336.0 1 1 24 - 1 0 - ROOF Slope Gross Area ROOF SKYLIGHT	N
Exp (deg) (sqft) Type Type Qty	
No partition data for this space.	

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*****************	*****
GENERAL SCHEDULES	
Name: AHU 4-7 Offices Lighting: Lights	
Floor Area: 710.0 sqft Task Lights.: Lights	
Building Weight.: 70.0 lb/sqft People: People	
Windows Shaded? N Equipment: People	
Partitions Used.? N Misc. Sens: People	
LIGHTING Misc. Latent: People	
Overhead Fixture: Recessed INFILTRATION	
Lamp Wattage: 2.50 W/sqft Cooling: 0.00 CFM/	-
Ballast Mult: 1.00 Heating: 0.00 CFM/	-
Task Lighting: 0.00 W/sqft Typical: 0.00 CFM/	sqft
PEOPLE When Fan On.? N	
Occupancy: 236.0 sqft/per FLOOR	
Activity Level: Office Work Type:Slab On Grade	
Sensible: 245.0 BTU/hr Perimeter:	0.0 ft
	710.0 sqft
OTHER LOADS Floor R-Value:	2.40
Equipment: 0.00 W/sqft Insulation R-value:	0.00
Misc. Sensible: 3000.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
No external wall or window data for this space.	
	=======================================
ROOF Slope Gross Area ROOF SKYLIGHT	
Exp (deg) (sqft) Type Type Qty	
TION	
HOR - 710.0 1 2 0	
No newbition data for this grass	:=======
No partition data for this space.	

Prepared by: EINHO	RN YAFFEE	PRESCO	TT					12-30-94
HAP v3.04								Page 1
******	*****	****	****	*****	*****	*****	****	******
GENERAL			S	CHEDULES	3			
Name: AHU 5	Acivity R	loom		Lighting	g: :	Lights		
Floor Area:	3545.0	sqft		Task Lig	hts.:	Lights		
Building Weight.:	70.0	lb/sq	ft :	People.	: 3	Assemb	ly Spac	ces
Windows Shaded?	N	Ī		Equipmen	nt:	People		
Partitions Used.?	N	I		Misc. Se				
LIGHTING]	Misc. La	atent:	People		
Overhead Fixture:	Recessed		I	NFILTRA	rion	_		
Lamp Wattage:	2.80	W/sqf	t	Cooling	:	0	.00 CF	M/sqft
Ballast Mult:	1.00		:	Heating	:	0	.00 CF	M/sqft
Task Lighting:	0.00	W/sqf		Typical			.00 CF	
PEOPLE				When Far			N	, 1
Occupancy:	177.0	sqft/	per F	LOOR				
Activity Level:			_	Туре	: S	lab On	Grade	
Sensible:		BTU/h		Perimete				200.0 ft
Latent:		BTU/h		Slab Flo				3545.0 sqft
OTHER LOADS				Floor R	-Value.		:	2.40
Equipment:	4500.0	W		Insulat				0.00
Misc. Sensible:								
Misc. Latent:		BTU/h						
					======	=====	=====:	
WALL Gross Area	WALL	W	INDOW		W.	INDOW		Any
Exp (sqft)	Type	Type	Otv	Shade	Type	Otv	Shade	Doors?
W 152.0	1 1	1	0	-	1	0	-	N
E 1510.0	1 1	1	510	_	1	0	-	N
NW 385.0	1 1	1	0	_	1	0	-	N
N 290.0	1 1	1	0	_	1	0	-	N
S 476.0	1	1	0	-	1	0		N
ROOF Slope Gro	ss Area	ROOF	SKV	====== LIGHT	====== 	=====	:	
Exp (deg)	(sqft)		Type					
HOR -	3545.0	1	2	0				
No partition data			=====	=====			=====	

		SPACE	DESCI	CIPILOM					
Prepared by: EINHOR	RN YAFFEE P	RESCOT	T					12-30-	-94
HAP v3.04								Page	1
*****	*****	*****	****	*****	*****	****	*****	*******	**
GENERAL			SC	HEDULES	;				
Name: AHU 6	Travel / K	itchen	1 I	ighting	· · · · :	Lights	3		
Floor Area:	2048.0	sqft	7	ask Lig	hts.:	Lights	5		
Building Weight.: Windows Shaded?	70.0	lb/sqf	t I	eople	:	People	9		
Windows Shaded?	N		E	quipmen	it:	People	3		
Partitions Used.?	Y			Misc. Se					
LIGHTING			N	lisc. La	tent:	People	<u> </u>		
Overhead Fixture:	Recessed		II	FILTRAT	CION	-			
Lamp Wattage:	2.80	W/sqft	: (Cooling.	:	(0.00 CE	M/saft	
Ballast Mult:		-		leating.				_	
Task Lighting:		W/saft		ypical.		(0.00 CE	M/sqft	
PEOPLE		, 1		Then Fan			N	, 4	
Occupancy:	165.0	sqft/p	er FI	OOR					
Activity Level:	Office Wor	k	7	ype	:S	lab Or	n Grade	9	
Sensible:	245.0	BTU/hr	- I	erimete					-
Latent:	205.0	BTU/hr		lab Flo				992.0 sc	
OTHER LOADS		,		Floor R-				2.40	1
Equipment:	0.0	W		nsulati				0.00	
Misc. Sensible:	5000.0	BTU/hr	•						
Misc. Latent:									
				======	.=====	=====		========	===
WALL Gross Area	WALL	WI	MDOM		W	INDOW		Any	
Exp (sqft)	Type	Type	Qty	Shade	Type	Qty	Shade	Doors?	
								·	
N 325.0	1 1	1	0	-	1	0	-	N	
	=========	=====		.=====	=====	:			===
ROOF Slope Gros	ss Area	ROOF	SKYI	JIGHT					
	(sqft)								
HOR -	2048.0	1	2	0					
=======================================			=====	======					===
PARTITION LOADS	T_{Y}	pe 1			T	ype 2			
Туре					Ceil	ing			
Area	: 3	45.0 s	gft				sqft		
U-value	: C	.080 E	BTU/hi	:/sqft/E	7	0.500	BTU/hi	:/sqft/F	
Maximum Space Temp	:	95.0 F	र			75.0			
Maximum Space Temp Outside Air Temp @	Max:	95.0 F	?			55.0	F		
Minimum Space Temp		0.0 F				75.0	F		
Outside Air Temp @		0.0 F	?			54.0	F		
_									

1. SYSTEM NAME AND TYPE Name: AHU-1 Baseline Type: CONSTANT VOLUME Number of Zones.: 1	Page 1
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	2135.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Configuration:	Draw-Thru
Fan Total Static:	2.00 in.wg.
Fan Efficiency RETURN FAN DATA	54 %
	Backward Inclined or Airfoil
Fan Type Fan Total Static	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

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Name: AHU-1 Baseline	08-15-99		
Type: CONSTANT VOLUME - Single Zone			
Prepared by: EINHORN TAFFEE PRESCOT	T Page 2		
3. ZONE DATA			
3. ZONE DATA			
ZONE	1 (All Zones the Same)		
T-Stat Occupied Cooling(F):	75.0		
Unoccupied Cooling(F):	85.0		
Occupied Heating(F):	70.0		
Unoccupied Heating(F):	55.0		
Throttling Range(F):	3.0		
Zone Heating Unit Type:	Skin BB		
Trip Temperature(F):	35.0		
Design Supply Temperature(F):	-		
Fan Total Static(in.wg.):	-		
Fan Efficiency(%):	-		
	Diffuser		
Reheat Coil?	N		
Direct Exhaust Airflow(CFM):	0.0		
Direct Exhaust Fan kW(kW):	0.0		
4. SCHEDULE DATA			
4. SCHEDULE DATA	=======================================		
4. SCHEDULE DATA	0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0	0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0	=======================================		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 1 2 3 4	0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 X X X X X X X X X X X X X X X X X X		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 x x x x x x x x x x x x x x x x x x x		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day	0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day X X X X X X X X X	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 X X X X X X X X X X X X X X X X X X X		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 1 2 3 4 Design Day.	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 X X X X X X X X X X X X X X X X X X X		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 1 2 3 4 Design Day. X X X X X X X X X	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 X X X X X X X X X X X X X X X X X X		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 1 2 3 4 Design Day	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 X		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day X X X X X X X X X	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day. X X X X X X Weekday. X X X X X X X X X	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2		
4. SCHEDULE DATA HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 1 2 3 4 Design Day. X X X X X X X X X	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2		

	EN INPUI DAIA
Name: AHU-2 Baseline	12-30-94
Type: CONSTANT VOLUME - Multizone	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	
*********	***********
1. SYSTEM NAME AND TYPE	
Name AHU-2 Baseline	
Type CONSTANT VOLUM	E - Multizone
Number of Zones.: 3	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Cold Deck Temperature:	55.0 F
Coil Bypass Factor:	0.100
Cold Deck Reset:	Not Used
HEATING SYSTEM DATA	
Hot Deck Temperature:	110.0 F
Hot Deck Reset	Not Used
OUTDOOR VENTILATION DATA	Not obca
	Constant Nimfley Date
Type of Control	Constant Airflow Rate
Design Ventilation Airflow:	4300.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Forward Curved
Fan Total Static:	2.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	31 0
Outdoor Economizer Type:	None
	Notice
PREHEAT COIL	27
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %
=======================================	=======================================

Name: AHU-2 Baseline

08-15-95 Type: CONSTANT VOLUME - Multizone HAP v3.04 Prepared by: EINHORN YAFFEE PRESCOTT Page 2 ******************** 3. ZONE DATA ZONE 1 (All Zones the Same) T-Stat Occupied Cooling....(F): 75.0 Unoccupied Cooling..(F): 85.0 Occupied Heating....(F): 70.0 Unoccupied Heating..(F): 55.0 Throttling Range....(F): 3.0 Zone Heating Unit Type.....: None Trip Temperature.....(F): Design Supply Temperature(F): Fan Total Static....(in.wg.): Fan Efficiency.....(%): Zone Terminal Type..... CAV MBox Reheat Coil....? N Diversity Factor....(%): 100 Direct Exhaust Airflow...(CFM): 200.0 Direct Exhaust Fan kW....(kW): 0.1 ______ 4. SCHEDULE DATA 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 Cooling Available During Unoccupied Period ? Y ______ MONTHLY SCHEDULES | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ______ Central Heating...... | XXX | Central Cooling..... | | | XXX

Name: AHU-3 Baseline Type: CONSTANT VOLUME - Single Zon Prepared by: EINHORN YAFFEE PRESCO						
1. SYSTEM NAME AND TYPE						
Name: AHU-3 Baseline Type: CONSTANT VOLUME - Single Zone CAV Number of Zones.: 1						
2. SYSTEM DESCRIPTION						
COOLING SYSTEM DATA Is Central Cooling Used?	Y					
Supply Air:	55.0 F					
Coil Bypass Factor	0.100					
Fan Cycled for Cooling?	N					
Supply Air Reset: HEATING SYSTEM DATA	Not Used					
Is Central Heating Used?	Y					
Fan Cycled for Heating?	N					
Supply Air Reset:	Not Used					
OUTDOOR VENTILATION DATA						
Type of Control:	Constant Airflow Rate					
Design Ventilation Airflow:	720.0 CFM					
Dampers Open During Unocc Per.:	И					
Damper Leak Rate:	2 %					
SUPPLY DUCT DATA Duct Heat Gain:	2 %					
Duct Leakage Rate	5 %					
RETURN PLENUM DATA	5 .					
Is a Return Plenum Used?	N					
SUPPLY FAN DATA						
Fan Type:	Backward Inclined or Airfoil					
Configuration:	Draw-Thru					
Fan Total Static:	1.50 in.wg.					
Fan Efficiency:	54 %					
RETURN FAN DATA	Designed Inclined on Dinfeil					
Fan Type Fan Total Static	Backward Inclined or Airfoil 0.25 in.wg.					
Fan Efficiency	0.25 in.wg.					
OUTDOOR AIR ECONOMIZER	J = 0					
Outdoor Economizer Type:	None					
PREHEAT COIL						
Preheat Coil Used?	N					
PRECOOL COIL						
Precool Coil Used?	N					
HUMIDIFICATION						
Humidification System Used?	N					
DEHUMIDIFICATION	AT.					
Dehumidification System Used?	N					
VENTILATION HEAT RECLAIM Reclaim Unit Type:	None					
SAFETY FACTORS	NOTE					
Sensible Cooling Factor:	O %					
Latent Cooling Factor:	0 %					
Heating Factor:	0 %					
_	=======================================					

Name: AHU-3 Baseline Type: CONSTANT VOLUME - Single Zo Prepared by: EINHORN YAFFEE PRESC ********	ne CAV HAP	-15-95 v3.04 age 2
3. ZONE DATA		
ZONE	1 (All Zones the Same)	
T-Stat Occupied Cooling(F):	75.0	
Unoccupied Cooling (F):	85.0	
Occupied Heating(F):	70.0	
Unoccupied Heating(F):	55.0	
Throttling Range(F):	3.0	
Zone Heating Unit Type:	Skin BB	
Trip Temperature(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static(in.wg.):	-	
Fan Efficiency(%):	-	
Zone Terminal Type:	Diffuser	
Reheat Coil?	N	
Direct Exhaust Airflow(CFM):	900.0	
Direct Exhaust Fan kW(kW):	0.1	
4. SCHEDULE DATA		
HOURLY TSTAT SCHEDULES 0 0 0 0	0 0 0 0 0 1 1 1 1 1 1 1 1 1 2 2	2 2 2
0 1 2 3	4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 3	L 2 3
	,	
	x x x x x x x x x x x x x x x x x x x	
	x x x x x x x x x x x x x x x x x x x	
	x x x x x x x x x x x x x x x x x x x	
=	x x x x x x x x x x x x x x x x x x x	
	=======================================	
Cooling Available During Unoccupi		
MONTHLY SCHEDULES JAN FEB	MAR APR MAY JUN JUL AUG SEP OCT NO	\ DEC
Space/Skin Heating XXX XXX	xxx xxx	y I yyy
-		
Central Heating XXX XXX		
Central Cooling	xxx xxx xxx xxx xxx xxx xxx xxx	v

Name: AHU-4 Baseline	12-30-94
Type: CONSTANT VOLUME - Multizone	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	TT Page 1
*******	**********
1. SYSTEM NAME AND TYPE	
_ :	
Name AHU-4 Baseline	
Type CONSTANT VOLUM	E - Multizone
Number of Zones.: 7	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Cold Deck Temperature:	55.0 F
	0.100
	Not Used
HEATING SYSTEM DATA	100 0000
Hot Deck Temperature:	110.0 F
Hot Deck Reset	Not Used
OUTDOOR VENTILATION DATA	1100 0000
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	2160.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Forward Curved
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	И
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

Name: AHU-4 Baseline	08-15-95
Type: CONSTANT VOLUME - Multizone	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	OTT Page 2
*********	***********
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
Zone Heating Unit Type:	None
Trip Temperature(F):	-
Design Supply Temperature(F):	-
Fan Total Static(in.wg.):	-
Fan Efficiency(%):	-
Zone Terminal Type:	CAV MBox
Reheat Coil?	N
Diversity Factor(%):	100
Direct Exhaust Airflow(CFM):	0.0
Direct Exhaust Fan kW(kW):	0.0

4. SCHEDULE DATA	
	0 0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2
[0]1 2 3 4	1 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Davis Davis Davis Ivivivis	
	X X X X X X X X X X
	X X X X X X X X X X
	X X X X X X X X X X
======================================	x x x x x x x x x x x x x x x x x x x
Cooling Available During Unoccupie	ed Period ? Y
MONTHLY SCHEDULES JAN FEB N	MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
PONTINE SCHEDOLLO OAN LES	
Central Heating XXX XXX X	
	xxx xxx xxx xxx xxx xxx xxx xxx

Name: AHU-5 Baseline	12-30-94
Type: CONSTANT VOLUME - Single Zone	CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOT	

1. SYSTEM NAME AND TYPE	
Name AHU-5 Baseline	
Type CONSTANT VOLUME	- Single Zone CAV
Number of Zones.: 1	•
=======================================	=======================================
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	960.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Forward Curved
Configuration:	
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	D
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	Warra a
Outdoor Economizer Type:	None
PREHEAT COIL	NT.
Preheat Coil Used?	N
PRECOOL COIL	AT.
Precool Coil Used?	И
HUMIDIFICATION	λŢ
Humidification System Used?	И
DEHUMIDIFICATION Dehumidification System Used 2	N
Dehumidification System Used? VENTILATION HEAT RECLAIM	N
	None
Reclaim Unit Type SAFETY FACTORS	110110
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor	0 %
=======================================	

	M INPUL DATA
Name: AHU-5 Baseline	08-15-95
Type: CONSTANT VOLUME - Single Zone	
Prepared by: EINHORN YAFFEE PRESCOT	
**********	************
3. ZONE DATA	
CONT	1 (711 Famor the Come)
ZONE T-Stat Occupied Cooling(F):	1 (All Zones the Same) 75.0
Unoccupied Cooling(F):	
-	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
Zone Heating Unit Type:	Skin BB
Trip Temperature(F):	35.0
Design Supply Temperature(F):	-
Fan Total Static(in.wg.):	-
Fan Efficiency(%):	-
Zone Terminal Type:	Diffuser
Reheat Coil?	N
Direct Exhaust Airflow(CFM):	0.0
Direct Exhaust Fan kW(kW):	0.0
=======================================	
4. SCHEDULE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0 0	0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2
0 1 2 3 4	5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Design Day X X X X	$X \mid X \mid$
Weekday X X X X X X	$X \mid X \mid$
Saturday X X X X X X	X X X X X X X X X X X X X X X X X X X
Sunday $ X X X X $	X X X X X X X X X X X X X X X X X X X
Cooling Available During Unoccupied	l Period ? Y
MONTHLY SCHEDULES JAN FEB MA	R APR MAY JUN JUL AUG SEP OCT NOV DEC
Space/Skin Heating XXX XXX XX	XXX XXX XX XXX XXX XX
Central Heating XXX XXX XX	XXX XXX
Central Cooling XX	
=======================================	

and the second

Name: AHU-6 Baseline	12-30-94
Type: CONSTANT VOLUME - Single Zon	
Prepared by: EINHORN YAFFEE PRESCO	
**********	*************
1. SYSTEM NAME AND TYPE	
Name AHU-6 Baseline	
Type CONSTANT VOLUM	iE - Single Zone CAV
Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	N
HEATING SYSTEM DATA	
Supply Air Temperature?	110.0 F
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	100 %
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	И
SUPPLY FAN DATA	
Fan Type:	Forward Curved
Configuration:	Draw-Thru
Fan Total Static:	1.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
VENTILATION HEAT RECLAIM	None
Reclaim Unit Type:	None
SAFETY FACTORS	0 %
Sensible Cooling Factor: Latent Cooling Factor:	0 %
Heating Factor:	0 %

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Name: AHU-6 Baseline Type: CONSTANT VOLUME - Single Prepared by: EINHORN YAFFEE PRE	SCOTT	****	08-15-95 HAP v3.04 Page 2
3. ZONE DATA			
ZONE	1	(All Zones	s the Same)
T-Stat Occupied Cooling(F):	75.0		
Unoccupied Cooling(F):	85.0		
Occupied Heating(F):	70.0		
Unoccupied Heating(F):	55.0		
Throttling Range(F):	3.0		
Zone Heating Unit Type:	Skin BB		
Trip Temperature(F):	35.0		
Design Supply Temperature(F):	-		
Fan Total Static(in.wg.):	-		
Fan Efficiency(%):	-166		
Zone Terminal Type:	Diffuser		
Reheat Coil?	N		•
Direct Exhaust Airflow(CFM):	5400.0 1.4		
Direct Exhaust Fan kW(kW):			
4. SCHEDULE DATA			
=======================================	==========		
HOURLY TSTAT SCHEDULES 0 0 0	01010101010	0 1 1 1 1 1	1 1 1 1 1 2 2 2 2
			5 6 7 8 9 0 1 2 3
Design Day X X X	x x x x x x x	x x x x x x	X X X X X X X X X X
Weekday X X X			
Saturday X X X			
Sunday X X X			
MONTHLY GOVERNMENT IN TANKER			======================================
MONTHLY SCHEDULES JAN FE	D MAK APK MA)	T TOOK TOOK A	PG SEE OCT MOV DEC
Space/Skin Heating XXX XX	x xxx xxx		xxx xxx xxx
Central Heating		x xxx xxx x	
central heating			

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1. SYSTEM NAME AND TYPE	T Page 1 ***********************************
Name: AHU-1 PLC Type: CONSTANT VOLUME	2 - Single Zone CAV
Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset HEATING SYSTEM DATA	Not Used
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset OUTDOOR VENTILATION DATA	Not Used
Type of Control:	
Design Ventilation Airflow:	2135.0 CFM
Dampers Open During Unocc Per.:	N o o
Damper Leak Rate:	2 %
SUPPLY DUCT DATA Duct Heat Gain	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	3 *
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Configuration:	Draw-Thru
Fan Total Static:	2.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	Deviluand Tables & on Place 11
Fan Type:	Backward Inclined or Airfoil
Fan Total Static Fan Efficiency	0.25 in.wg. 54 %
OUTDOOR AIR ECONOMIZER	34 %
Outdoor Economizer Type:	None
PREHEAT COIL	1.0110
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	۸ %
Sensible Cooling Factor:	0 % 0 %
Latent Cooling Factor: Heating Factor	0 %
	0

Name: AHU-1 PLC		12-30-94
Type: CONSTANT VOLUME - Single Zo:		HAP v3.04
Prepared by: EINHORN YAFFEE PRESC	OTT	Page 2
*********	******	********
3. ZONE DATA		
ZONE	1 (2	All Zones the Same)
T-Stat Occupied Cooling(F):	75.0	,
Unoccupied Cooling (F):	85.0	
Occupied Heating(F):	70.0	
Unoccupied Heating (F):	55.0	
Throttling Range(F):	3.0	
Zone Heating Unit Type:	Skin BB	
Trip Temperature(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static(in.wg.):	-	
Fan Efficiency(%):	-	
Zone Terminal Type:	Diffuser	
Reheat Coil?	N	
Direct Exhaust Airflow(CFM):	0.0	
Direct Exhaust Fan kW(kW):	0.0	
	=======================================	
4. SCHEDULE DATA		
TOTAL A TOTAL ACTION TO		
		1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2
[0]1[2]3]	4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0 1 2 3
Design Day	v v v v	x x x x x x x x x x x x
Weekday		X X X X X X X X X X
Saturday		
Sunday		X X X X X X X
Cooling Available During Unoccupi		N
MONTHLY SCHEDULES JAN FEB	MAR APR MAY J	UN JUL AUG SEP OCT NOV DEC
Space/Skin Heating XXX XXX	xxx	
Central Heating XXX XXX		
Central Cooling	xxx xxx xxx x	XXX XXX XXX XXX

Name: AHU-2 PLC Type: CONSTANT VOLUME - Multizone Prepared by: EINHORN YAFFEE PRESCO'	12-30-94 HAP v3.04 TT Page 1
1. SYSTEM NAME AND TYPE	
Name: AHU-2 PLC Type: CONSTANT VOLUMI Number of Zones.: 3	E - Multizone
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Cold Deck Temperature:	55.0 F
Coil Bypass Factor	0.100
Cold Deck Reset: HEATING SYSTEM DATA	
Hot Deck Temperature:	110.0 F
	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	
Design Ventilation Airflow:	4300.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	2 %
Duct Heat Gain	
Duct Leakage Rate	5 %
Is a Return Plenum Used? SUPPLY FAN DATA	N
Fan Type:	Forward Curved
Fan Total Static:	2.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL Preheat Coil Used?	N .
PRECOOL COIL	-
Precool Coil Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

Name: AHU-2 PLC 12-30-94 Type: CONSTANT VOLUME - Multizone HAP v3.04 Prepared by: EINHORN YAFFEE PRESCOTT Page 2 ******************* 3. ZONE DATA ZONE (All Zones the Same) T-Stat Occupied Cooling....(F): 75.0 Unoccupied Cooling..(F): 85.0 70.0 Occupied Heating...(F): 55.0 Unoccupied Heating .. (F): Throttling Range....(F): 3.0 Zone Heating Unit Type....: None Trip Temperature.....(F): Design Supply Temperature(F): Fan Total Static....(in.wg.): Fan Efficiency.....(%): Zone Terminal Type....: Reheat Coil....? N Diversity Factor....(%): 100 Direct Exhaust Airflow...(CFM): 200.0 Direct Exhaust Fan kW....(kW): _____ 4. SCHEDULE DATA 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 Design Day..... Sunday..... | | | | | Cooling Available During Unoccupied Period ? N ______ MONTHLY SCHEDULES | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ______ ? In some the reason of

Name: AHU-3 PLC Type: CONSTANT VOLUME - Single Zone Prepared by: EINHORN YAFFEE PRESCON	
1. SYSTEM NAME AND TYPE	
Name: AHU-3 PLC Type: CONSTANT VOLUME Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA Is Central Cooling Used?	Y
Supply Air	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset HEATING SYSTEM DATA	Not Used
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset OUTDOOR VENTILATION DATA	Not Used
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	720.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	2 %
Duct Heat Gain:	2 % 5 %
Duct Leakage Rate RETURN PLENUM DATA	5 6
Is a Return Plenum Used?	N
SUPPLY FAN DATA	Backward Inclined or Airfoil
Fan Type: Configuration:	Draw-Thru
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	1-
Humidification System Used?	N
DEHUMIDIFICATION	N
Dehumidification System Used? VENTILATION HEAT RECLAIM	N
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

Name: AHU-3 PLC			12-30-94
Type: CONSTANT VOLUME - Single Zon	ne CAV		HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	OTT		Page 2
*********	*****	*****	******
3. ZONE DATA			
ZONE (E)	1	(All Zones	the Same)
T-Stat Occupied Cooling(F): Unoccupied Cooling(F):	75.0 85.0		
Occupied Heating(F):	70.0		
Unoccupied Heating(F):	55.0		
Throttling Range(F):	3.0		
Zone Heating Unit Type:	Skin BB		
Trip Temperature(F):	35.0		
Design Supply Temperature(F):	35.0		
Fan Total Static(in.wg.):	_		
Fan Efficiency(%):	_		
Zone Terminal Type:	Diffuser		
Reheat Coil?	N		
Direct Exhaust Airflow(CFM):	900.0		
Direct Exhaust Fan kW(kW):	0.1		
4. SCHEDULE DATA			
			==========
HOURLY TSTAT SCHEDULES 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 2 2 2 2 2
0 1 2 3	4 5 6 7 8 9	0 1 2 3 4 5	6 7 8 9 0 1 2 3
Design Day	x x x	X X X X X	X X X X X X
Weekday	x x x	X X X X X X	X X X X X X X
Saturday		x x x x	X X X X X X X
Sunday		x x x x x	X X X
Cooling Available During Unoccupi	ed Period ?	N	
	========		
MONTHLY SCHEDULES JAN FEB 1	MAR APR MAY	JUN JUL AUG	SEP OCT NOV DEC
One no foliar traction vvv vvv		1 1 1	
Space/Skin Heating XXX XXX	: :		XXX XXX XXX
Central Heating XXX XXX			XXX XXX XXX XXX
Central Cooling	vvv vvv vvv	xxx xxx xxx	

Name: AHU-4 PLC Type: CONSTANT VOLUME - Multizone Prepared by: EINHORN YAFFEE PRESCO	12-30-94 HAP v3.04 TT Page 1
1. SYSTEM NAME AND TYPE	
Name AHU-4 PLC	
Type CONSTANT VOLUM	E - Multizone
Number of Zones.: 7	
=======================================	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Cold Deck Temperature:	55.0 F
Coil Bypass Factor:	
Cold Deck Reset:	
HEATING SYSTEM DATA	
Hot Deck Temperature:	110.0 F
Hot Deck Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	2160.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	Farmer d. Greene d.
Fan Type:	
Fan Total Static:	1.50 in.wg. 54 %
Fan Efficiency RETURN FAN DATA	34 °
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

Name: AHU-4 PLC Type: CONSTANT VOLUME - Multizone	12-30-94 HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	

3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating (F):	55.0
Throttling Range(F):	3.0
Zone Heating Unit Type:	None
Trip Temperature(F):	-
Design Supply Temperature(F):	-
Fan Total Static(in.wg.):	-
Fan Efficiency(%):	-
Zone Terminal Type:	CAV MBox
Reheat Coil?	N
Diversity Factor(%):	100
Direct Exhaust Airflow(CFM):	0.0
Direct Exhaust Fan kW(kW):	0.0
4. SCHEDULE DATA	
4. SCHEDOLE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0	0000001111111111111112222
	5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
F1,C121101	
Design Day	
Weekday	
Saturday	
Sunday	
=======================================	
Cooling Available During Unoccupie	
	AR APR MAY JUN JUL AUG SEP OCT NOV DEC
Central Heating XXX XXX XX XXX XX	

Name: AHU-5 PLC	12-30-94
Type: CONSTANT VOLUME - Single Zone	e CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	

1. SYSTEM NAME AND TYPE	
Name AHU-5 PLC	
Type CONSTANT VOLUM	F - Single Zone CAV
Number of Zones.: 1	E - Biligie Zolle CAV
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control	Constant Airflow Rate
Design Ventilation Airflow:	960.0 CFM
	N
Dampers Open During Unocc Per.:	2 %
Damper Leak Rate:	2 6
SUPPLY DUCT DATA	2 4
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Forward Curved
	Draw-Thru
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	41
Humidification System Used?	N
	N
DEHUMIDIFICATION	N
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	NT
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

Name: AHU-5 PLC	12-30-94
Type: CONSTANT VOLUME - Single Zone Ca	AV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT	Page 2
**********	**********
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
22.00	kin BB
Trip Temperature(F):	35.0
Design Supply Temperature(F):	-
Fan Total Static(in.wg.):	-
Fan Efficiency(%):	-
I Transfer of the second secon	ffuser
Reheat Coil?	N
Direct Exhaust Airflow(CFM):	0.0
Direct Exhaust Fan kW(kW):	0.0
4. SCHEDULE DATA	
4. SCHEDOLE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0 0	0 0 0 0 1 1 1 1 1 1 1 1 1 2 2 2 2
	6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Design Day	x x x x x x x x x x x x x x x
Weekday	
Saturday	
Sunday	
Cooling Available During Unoccupied P	eriod ? N
	=======================================
MONTHLY SCHEDULES JAN FEB MAR	APR MAY JUN JUL AUG SEP OCT NOV DEC
Space/Skin Heating XXX XXX XXX	
Central Heating XXX XXX XXX	
Central Cooling XXX	XXX XXX XXX XXX

Name: AHU-6 PLC	12-30-94
Type: CONSTANT VOLUME - Single Zon	
Prepared by: EINHORN YAFFEE PRESCO	
********	*************
1 CYCTEM NAME AND TYPE	
1. SYSTEM NAME AND TYPE	
Name AHU-6 PLC	
Type CONSTANT VOLUM	ME - Single Zone CAV
Number of Zones.: 1	5111910 10110 0117
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	N
HEATING SYSTEM DATA	
Supply Air Temperature?	110.0 F
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	100 %
Dampers Open During Unocc Per .:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	Farmered Commend
Fan Type	Forward Curved Draw-Thru
Configuration	1.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	34 6
Fan Type	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
VENTILATION HEAT RECLAIM	•
Reclaim Unit Type:	None
SAFETY FACTORS	0.0
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 % 0 %
Heating Factor:	U 8

Name: AHU-6 PLC Type: CONSTANT VOLUME - Sing Prepared by: EINHORN YAFFEE **********************************	PRESCO	OTT	*****	*****	12-30-94 HAP v3.04 Page 2
3. ZONE DATA					
ZONE			1 (All Zo	nes the	Same)
T-Stat Occupied Cooling	(F):	75.			,
Unoccupied Cooling(85.			
Occupied Heating		70.	0		
Unoccupied Heating (55.	0		
Throttling Range(3.	0		
Zone Heating Unit Type		Skin B	В		
Trip Temperature		35.			
Design Supply Temperature	(F):		-		
Fan Total Static(in.wg	Ţ.):		_		
Fan Efficiency	(응) :		-		
Zone Terminal Type	:	Diffuse	r		
Reheat Coil	?		N		
Direct Exhaust Airflow(CF	M):	5400.	0		
Direct Exhaust Fan kW(k	: (W	1.	4		
=======================================		=======		======	==========
4. SCHEDULE DATA					
				======	=========
· · · · · · · · · · · · · · · · · · ·	1 1 1	1 1 1 1			1 1 1 2 2 2 2
0 1	. 2 3 4	4 5 6 7 8	9 0 1 2 3	4 5 6	7 8 9 0 1 2 3
		1 1 1-1-			
Design Day					x x x x x x
Weekday		X X			x x x x x x
Saturday					x x x x x x
Sunday			x x x x	$ \mathbf{x} \mathbf{x} \mathbf{x}$	x x
MONTHLY SCHEDULES JAN	1 FEB 1	====== MAR APR M	AY JUN JUL	AUG SE	P OCT NOV DEC
Space/Skin Heating XXX					XXX XXX XXX
Central Heating XXX	(XXX)	XXX XXX		XX	x xxx xxx xxx

Name: AHU-1 DDC Type: CONSTANT VOLUME - Single Zone Prepared by: EINHORN YAFFEE PRESCO	
1. SYSTEM NAME AND TYPE	
Name: AHU-1 DDC Type: CONSTANT VOLUME Number of Zones.: 1	
	=======================================
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset	Not Used
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	
Design Ventilation Airflow:	2135.0 CFM
Dampers Open During Unocc Per.: Damper Leak Rate	N 2 %
SUPPLY DUCT DATA	2 6
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	•
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Configuration:	Draw-Thru
Fan Total Static:	2.00 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER Outdoor Economizer Type:	Integrated Enthalmy
OA Upper Cutoff Temp:	Integrated Enthalpy 95.0 F
OA Lower Cutoff Temp:	0.0 F
PREHEAT COIL	0.0 1
Preheat Coil Used?	N
PRECOOL COIL	- '
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None

Name: AHU-1 DDC Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT ***********************************	12-30-94 HAP v3.04 Page 2	
2. SYSTEM DESCRIPTION (CONTINUED)		
SAFETY FACTORS Sensible Cooling Factor: Latent Cooling Factor: Heating Factor:	0 % 0 % 0 %	
3. ZONE DATA		
ZONE T-Stat Occupied Cooling(F): 75.0 Unoccupied Cooling(F): 85.0 Occupied Heating(F): 70.0 Unoccupied Heating(F): 55.0 Throttling Range(F): 3.0 Zone Heating Unit Type: Skin BB Trip Temperature(F): 35.0 Design Supply Temperature(F): - Fan Total Static(in.wg.): - Fan Efficiency(%): - Zone Terminal Type: Diffuser Reheat Coil? N Direct Exhaust Airflow(CFM): 0.0 Direct Exhaust Fan kW(kW): 0.0	(All Zones the Same)	
4. SCHEDULE DATA		
	0 1 1 1 1 1 1 1 1 1	
Cooling Available During Unoccupied Period ? N		
	Y JUN JUL AUG SEP OCT NOV DEC	
_ , , ,		

Name: AHU-2 DDC 12-30-94 Type: CONSTANT VOLUME - Multizone HAP v3.04 Prepared by: EINHORN YAFFEE PRESCOTT Page 1 ***************** 1. SYSTEM NAME AND TYPE Name..... AHU-2 DDC Type..... CONSTANT VOLUME - Multizone Number of Zones.: 3 ______ 2. SYSTEM DESCRIPTION COOLING SYSTEM DATA Cold Deck Temperature....: 55.0 F Cold Deck Temperature....: 55.0 F

Coil Bypass Factor...: 0.100

Cold Deck Reset...: Greatest Demand Maximum Reset Temperature....: 60.0 F HEATING SYSTEM DATA Hot Deck Temperature....: 110.0 F Hot Deck Reset..... Greatest Demand Minimum Reset Temperature....: 90.0 F OUTDOOR VENTILATION DATA Type of Control....: Constant Airflow Rate 4300.0 CFM Design Ventilation Airflow...: Dampers Open During Unocc Per .: N Damper Leak Rate....: 2 % SUPPLY DUCT DATA Duct Heat Gain....: 2 % Duct Leakage Rate....: 5 % RETURN PLENUM DATA Is a Return Plenum Used....? SUPPLY FAN DATA Fan Type....: Forward Curved 2.00 in.wg. Fan Total Static....: 54 % Fan Efficiency....: RETURN FAN DATA Backward Inclined or Airfoil Fan Type....: 0.25 in.wq. Fan Total Static....: 54 왕 Fan Efficiency....: OUTDOOR AIR ECONOMIZER Integrated Enthalpy Outdoor Economizer Type....: OA Upper Cutoff Temp....: 95.0 F OA Lower Cutoff Temp....: 0.0 F PREHEAT COIL Preheat Coil Used....? Ν PRECOOL COIL Precool Coil Used....? N VENTILATION HEAT RECLAIM Reclaim Unit Type....: None SAFETY FACTORS Sensible Cooling Factor....: Latent Cooling Factor....: 0 왕 Heating Factor....: ______

Name: AHU-2 DDC Type: CONSTANT VOLUME - Multizone Prepared by: EINHORN YAFFEE PRESCO	12-30-94 HAP v3.04 TT Page 2
3. ZONE DATA	~ · · · · · · · · · · · · · · · · · · ·
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
Zone Heating Unit Type:	None
Trip Temperature(F):	_
Design Supply Temperature(F):	_
Fan Total Static(in.wg.):	
Fan Efficiency(%):	-
Zone Terminal Type:	CAV MBox
Reheat Coil?	N
Diversity Factor(%):	100
Direct Exhaust Airflow(CFM):	200.0
Direct Exhaust Fan kW(kW):	0.1
=======================================	
4. SCHEDULE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0	00000111111111111112222
0 1 2 3 4	5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Design Day	
Weekday	
Saturday	
Sunday	
=======================================	
Cooling Available During Unoccupie	d Period ? N
	AR APR MAY JUN JUL AUG SEP OCT NOV DEC
Central Heating XXX XXX X	xx xxx
	xx xxx xxx xxx xxx xxx xxx

The state of the s

Name: AHU-3 DDC Type: CONSTANT VOLUME - Single Zone Prepared by: EINHORN YAFFEE PRESCOT	
1. SYSTEM NAME AND TYPE	
Name: AHU-3 DDC Type: CONSTANT VOLUME Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset HEATING SYSTEM DATA	Not Used
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	720.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	Backward Inclined or Airfoil
Fan Type	Draw-Thru
Configuration	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	J. 1. 0
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	Integrated Enthalpy
OA Upper Cutoff Temp:	95.0 F
OA Lower Cutoff Temp:	0.0 F
PREHEAT COIL Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used? DEHUMIDIFICATION	И
Dehumidification System Used? VENTILATION HEAT RECLAIM	N
Reclaim Unit Type:	None

Name: AHU-3 DDC Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94 HAP v3.04 Page 2
2. SYSTEM DESCRIPTION (CONTINUED)	
SAFETY FACTORS Sensible Cooling Factor: Latent Cooling Factor: Heating Factor:	0 % 0 % 0 %
3. ZONE DATA	
ZONE 1 T-Stat Occupied Cooling(F): 75.0 Unoccupied Cooling(F): 85.0 Occupied Heating(F): 70.0 Unoccupied Heating(F): 55.0 Throttling Range(F): 3.0 Zone Heating Unit Type: Skin BB Trip Temperature(F): 35.0 Design Supply Temperature(F): - Fan Total Static(in.wg.): - Fan Efficiency(%): - Zone Terminal Type: Diffuser Reheat Coil? N Direct Exhaust Airflow(CFM): 900.0 Direct Exhaust Fan kW(kW): 0.1	(All Zones the Same)
4. SCHEDULE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 2 2 2 2 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Cooling Available During Unoccupied Period ?	
	JUN JUL AUG SEP OCT NOV DEC
_ , , , , , , , , , , , , , , , , , , ,	

Name: AHU-4 DDC	12-30-94
Type: CONSTANT VOLUME - Multizone	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOT	T Page 1

1. SYSTEM NAME AND TYPE	
Name AHU-4 DDC	
Type : CONSTANT VOLUME	E - Multizone
Number of Zones.: 7	
	=======================================
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Cold Deck Temperature:	55.0 F
Coil Bypass Factor:	0.100
Cold Deck Reset:	Greatest Demand
Maximum Reset Temperature:	60.0 F
HEATING SYSTEM DATA	
Hot Deck Temperature:	110.0 F
Hot Deck Reset:	Greatest Demand
Minimum Reset Temperature:	90.0 F
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	2160.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA Fan Type	Declared Inclined on Minfeil
Fan Total Static	0.25 in.wq.
	0.25 in.wg.
Fan Efficiency OUTDOOR AIR ECONOMIZER	J4 %
Outdoor Economizer Type:	Integrated Enthalpy
OA Upper Cutoff Temp	95.0 F
OA Lower Cutoff Temp:	0.0 F
PREHEAT COIL	0.01
Preheat Coil Used?	N
PRECOOL COIL	**
Precool Coil Used?	N
VENTILATION HEAT RECLAIM	-
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %
_	

Name: AHU-4 DDC Type: CONSTANT VOLUME - Multizone Prepared by: EINHORN YAFFEE PRESC ************************************	
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
Zone Heating Unit Type:	None
Trip Temperature(F):	-
Design Supply Temperature(F):	-
Fan Total Static(in.wg.):	-
Fan Efficiency(%):	-
Zone Terminal Type:	CAV MBox
Reheat Coil?	N
Diversity Factor(%):	100
Direct Exhaust Airflow(CFM):	0.0
Direct Exhaust Fan kW(kW):	0.0
=======================================	
4. SCHEDULE DATA	
	0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1
0 1 2 3	4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
	1
Design Day	
Weekday	
Saturday	
Sunday	
Cooling Available During Unoccupi	
MONTHLY SCHEDULES JAN FEB	MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Control Hosting Yvy yvy	VVV VVV
Central Heating XXX XXX	
Central Cooling	xxx xxx xxx xxx xxx xxx xxx

Name: AHU-5 DDC	12-30-94
Type: CONSTANT VOLUME - Single Zone	e CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOT	

1. SYSTEM NAME AND TYPE	
Name AHU-5 DDC	
Type : CONSTANT VOLUME	: - Single Zone CAV
Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Υ
Supply Air:	55.0 F
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	960.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	
Fan Type:	Forward Curved
Configuration:	
Fan Total Static:	1.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	Backward Inclined or Airfoil
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	Integrated Enthalpy
OA Upper Cutoff Temp:	95.0 F
OA Lower Cutoff Temp:	0.0 F
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	•
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	N
DEHUMIDIFICATION	- -
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	- ·
Reclaim Unit Type:	None

Name: AHU-5 DDC Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT ***********************************	12-30-94 HAP v3.04 Page 2
2. SYSTEM DESCRIPTION (CONTINUED)	
SAFETY FACTORS Sensible Cooling Factor: Latent Cooling Factor: Heating Factor:	0 % 0 % 0 %
3. ZONE DATA	
ZONE 1 T-Stat Occupied Cooling(F): 75.0 Unoccupied Cooling(F): 85.0 Occupied Heating(F): 70.0 Unoccupied Heating(F): 55.0 Throttling Range(F): 3.0	(All Zones the Same)
Zone Heating Unit Type: Skin BB Trip Temperature(F): 35.0 Design Supply Temperature(F): - Fan Total Static(in.wg.): - Fan Efficiency(%): - Zone Terminal Type: Diffuser Reheat Coil? N Direct Exhaust Airflow(CFM): 0.0 Direct Exhaust Fan kW(kW): 0.0	
4. SCHEDULE DATA	
	1 1 1 1 1 1 1 1 2 2
Weekday	
Cooling Available During Unoccupied Period ?	
	JUN JUL AUG SEP OCT NOV DEC
Space/Skin Heating XXX XXX XXX Central Heating XXX XXX	

Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT Page 1 ***********************************	Name: AHU-6 DDC	12-30-94
1. SYSTEM NAME AND TYPE Name	Type: CONSTANT VOLUME - Single Zone	e CAV HAP v3.04
Name	Prepared by: EINHORN YAFFEE PRESCOT	T Page 1
Name	**********	**********
Name		
Name		
Type: CONSTANT VOLUME - Single Zone CAV Number of Zones: 1		
Number of Zones:: 1 2. SYSTEM DESCRIPTION COOLING SYSTEM DATA Is Central Cooling Used? N HEATING SYSTEM DATA Supply Air Temperature? I10.0 F Fan Cycled for Heating? Not Used OUTDOOR VENTILATION DATA Type of Control		
2. SYSTEM DESCRIPTION COOLING SYSTEM DATA Is Central Cooling Used. ? N HEATING SYSTEM DATA Supply Air Temperature. ? 110.0 F Fan Cycled for Heating. ? N Supply Air Reset Not Used OUTDOOR VENTILATION DATA Type of Control Constant Airflow Rate Design Ventilation Airflow. : 100 % Dampers Open During Unocc Per: N Damper Leak Rate 2 % SUPPLY DUCT DATA Duct Heat Gain 2 % RETURN PLENUM DATA Is a Return Plenum Used. ? SUPPLY FAN DATA Fan Type Forward Curved Configuration Draw-Thru Fan Total Static . 1.00 in.wg. Fan Efficiency 54 % RETURN FAN DATA Fan Type None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type . None PREHEAT COIL Preheat Coil Used. ? N PRECOOL COIL Precool Coil Used. ? N		: - Single Zone CAV
COOLING SYSTEM DATA Is Central Cooling Used? N HEATING SYSTEM DATA Supply Air Temperature? 110.0 F Fan Cycled for Heating? N Supply Air Reset Not Used OUTDOOR VENTILATION DATA Type of Control Constant Airflow Rate Design Ventilation Airflow 100 % Dampers Open During Unocc Per Damper Leak Rate 2 % SUPPLY DUCT DATA Duct Heat Gain 2 % Duct Leakage Rate 5 % RETURN PLENUM DATA Is a Return Plenum Used? N SUPPLY FAN DATA Fan Type Forward Curved Configuration Prantal Static 1.00 in.wg. Fan Efficiency 54 % RETURN FAN DATA Fan Type None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type None PREMEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
COOLING SYSTEM DATA Is Central Cooling Used ? N HEATING SYSTEM DATA Supply Air Temperature. ? 110.0 F Fan Cycled for Heating. ? N Supply Air Reset Not Used OUTDOOR VENTILATION DATA Type of Control		
COOLING SYSTEM DATA Is Central Cooling Used ? N HEATING SYSTEM DATA Supply Air Temperature. ? 110.0 F Fan Cycled for Heating. ? N Supply Air Reset Not Used OUTDOOR VENTILATION DATA Type of Control	2 SYSTEM DESCRIPTION	
TS Central Cooling Used. ? N HEATING SYSTEM DATA Supply Air Temperature. ? 110.0 F Fan Cycled for Heating. ? N Supply Air Reset		
TS Central Cooling Used. ? N HEATING SYSTEM DATA Supply Air Temperature. ? 110.0 F Fan Cycled for Heating. ? N Supply Air Reset Not Used OUTDOOR VENTILATION DATA Type of Control		
Supply Air Temperature? 110.0 F Fan Cycled for Heating? N Supply Air Reset		N
Fan Cycled for Heating. ? Supply Air Reset	_	
Fan Cycled for Heating. ? Supply Air Reset		110.0 F
Supply Air Reset		N
OUTDOOR VENTILATION DATA Type of Control: Constant Airflow Rate Design Ventilation Airflow: 100 % Dampers Open During Unocc Per.: N Damper Leak Rate: 2 % SUPPLY DUCT DATA Duct Heat Gain		Not Used
Design Ventilation Airflow: 100 % Dampers Open During Unocc Per: N Damper Leak Rate: 2 % SUPPLY DUCT DATA Duct Heat Gain: 2 % Duct Leakage Rate: 5 % RETURN PLENUM DATA Is a Return Plenum Used? N SUPPLY FAN DATA Fan Type: Forward Curved Configuration: Draw-Thru Fan Total Static: 1.00 in.wg. Fan Efficiency: 54 % RETURN FAN DATA Fan Type: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
Dampers Open During Unocc Per:: N Damper Leak Rate	Type of Control:	Constant Airflow Rate
Damper Leak Rate	Design Ventilation Airflow:	100 %
SUPPLY DUCT DATA Duct Heat Gain	Dampers Open During Unocc Per.:	N
Duct Heat Gain	Damper Leak Rate:	2 %
Duct Leakage Rate		
RETURN PLENUM DATA Is a Return Plenum Used. ? N SUPPLY FAN DATA Fan Type Forward Curved Configuration Draw-Thru Fan Total Static 1.00 in.wg. Fan Efficiency 54 % RETURN FAN DATA Fan Type None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type None PREHEAT COIL Preheat Coil Used. ? N PRECOOL COIL Precool Coil Used. ? N		
Is a Return Plenum Used. ? N SUPPLY FAN DATA Fan Type. : Forward Curved Configuration. : Draw-Thru Fan Total Static. : 1.00 in.wg. Fan Efficiency. : 54 % RETURN FAN DATA Fan Type. : None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type. : None PREHEAT COIL Preheat Coil Used. ? N PRECOOL COIL Precool Coil Used. ? N		5 %
SUPPLY FAN DATA Fan Type		N.
Fan Type: Forward Curved Configuration.:: Draw-Thru Fan Total Static.:: 1.00 in.wg. Fan Efficiency.:: 54 % RETURN FAN DATA Fan Type.:: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type.:: None PREHEAT COIL Preheat Coil Used.:: N PRECOOL COIL Precool Coil Used.:: N		N
Configuration: Draw-Thru Fan Total Static: 1.00 in.wg. Fan Efficiency: 54 % RETURN FAN DATA Fan Type: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		Forward Curved
Fan Total Static 1.00 in.wg. Fan Efficiency 54 % RETURN FAN DATA Fan Type None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type None PREHEAT COIL Preheat Coil Used ? N PRECOOL COIL Precool Coil Used ? N		
Fan Efficiency: 54 % RETURN FAN DATA Fan Type: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
RETURN FAN DATA Fan Type: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
Fan Type: None OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N	_	
OUTDOOR AIR ECONOMIZER Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		None
Outdoor Economizer Type: None PREHEAT COIL Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
PREHEAT COIL Preheat Coil Used? PRECOOL COIL Precool Coil Used? N		None
Preheat Coil Used? N PRECOOL COIL Precool Coil Used? N		
Precool Coil Used? N	Preheat Coil Used?	N
THE TELESCOPE AND TO SELECT	Precool Coil Used?	N
	HUMIDIFICATION	
Humidification System Used? N		N
VENTILATION HEAT RECLAIM		
Reclaim Unit Type None		None
SAFETY FACTORS		0.0
Sensible Cooling Factor: 0 % Latent Cooling Factor: 0 %		
Latent Cooling Factor: 0 % Heating Factor: 0 %		
neating ractor	_	

Name: AHU-6 DDC 12-30-94												
	Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04											
Prepared by: EINHORN YAFFEE								شيال بالدياد			Page	
*****					****	***	* * * *	***	***	***	***	***
3. ZONE DATA												
ZONE				1	(All	Zoi	nes	the	Sam	e)		
T-Stat Occupied Cooling(F):		7!	5.0								
Unoccupied Cooling(F):		8	5.0								
Occupied Heating(F):		70	0.0								
Unoccupied Heating(5	5.0								
Throttling Range(F):		:	3.0								
Zone Heating Unit Type	:	5	Skin	BB								
Trip Temperature(3 !	5.0								
Design Supply Temperature(-								
Fan Total Static(in.wg				-								
Fan Efficiency(-								
Zone Terminal Type		D:	iffu									
Reheat Coil				N								
Direct Exhaust Airflow(CF			540									
Direct Exhaust Fan kW(k	W):		:	1.4								
=======================================	====	====:	====	====	=====	===:	=	===:	====	===	===:	====
4. SCHEDULE DATA												
	====							===:		===	===	====
HOURLY TSTAT SCHEDULES 0 0	00	0 0	0 0	000	1111	1 1	111	11	1 1	1 2	2 :	2 2
0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6	7 8	9 0	11:	2 3
Design Day					$ \mathbf{x} \mathbf{x} $							
Weekday			X	XX	X X							
Saturday			!!	!!			$ \mathbf{x} \mathbf{x}$: :		$X \mid X$	X :	x
Sunday					X X	$X \mid X$	X X	X 2	x x			
MONTHLY SCHEDULES JAN	FEB	MAR	APR	==== MAY	ומטע	JUL	AUG	SE	P OC	TN	ov :	DEC
Character Hocking	1000	 vvv		 I	1		 I	·	22	vlv	vvl	 vvv
Space/Skin Heating XXX Central Heating XXX								 vv			,	XXX
Central neating XXX	IVVV	IVVV	IVVV	1			I	IVV	A AA	A A	AA I	vvv

Name: AHU-1 Baseline			12-30-94
Type: CONSTANT VOLUME - Sin	gle Zone CA	V	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******	*****	******	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)	========		========
2. AHU-1 Assembly / Tra	vel 1		

Name: AHU-2 Baseline			12-30-94
Type: CONSTANT VOLUME - Mult			HAP v3.04
Prepared by: EINHORN YAFFEE			Page 1
********	*****	*********	*******
1. SPACE SELECTION			
	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)	======		========
3. AHU 2-1 Multi-Purpose			
SPACES IN ZONE 2 (Zone 2)			
4. AHU 2-2 Stage	1		
SPACES IN ZONE 3 (Zone 3)		·	
5. AHU 2-3 Multi-Purpose	1		

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HAP v3.04
Page 1

Qty
=======

Name: AHU-4 Baseline			12-30-94
Type: CONSTANT VOLUME - Mult	tizone		HAP v3.04
Prepared by: EINHORN YAFFEE			Page 1
*******	*****	*******	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
7. AHU 4-1 Music Room	1		
SPACES IN ZONE 2 (Zone 2)			
	1		
SPACES IN ZONE 3 (Zone 3)			
9. AHU 4-3 Mini Auditori	um 1		
SPACES IN ZONE 4 (Zone 4)			
10. AHU 4-4 Crafts Room	1		
SPACES IN ZONE 5 (Zone 5)			
11. AHU 4-5 Reading Room	1		
SPACES IN ZONE 6 (Zone 6)			
12. AHU 4-6 Office	1		
SPACES IN ZONE 7 (Zone 7)			
13. AHU 4-7 Offices	1		

Name: AHU-5 Baseline			12-30-94
Type: CONSTANT VOLUME - Sing	le Zone CAV	J .	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******	******	*******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
_	========		==========
SPACES IN ZONE 1 (Zone 1)			
14. AHU 5 Acivity Room	1		
•			

Name: AHU-6 Baseline Type: CONSTANT VOLUME - Singl Prepared by: EINHORN YAFFEE P	RESCOTT		12-30-94 HAP v3.04 Page 1
1. SPACE SELECTION		· 	
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
15. AHU 6 Travel / Kitchen	1		

Name: AHU-1 PLC Type: CONSTANT VOLUME - Singl	e Zone CAN		12-30-94
Prepared by: EINHORN YAFFEE F			HAP v3.04 Page 1
*******	*****	*******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
Space Name SPACES IN ZONE 1 (Zone 1)	Qty	Space Name	Qty ======

Name: AHU-2 PLC			12-30-94
Type: CONSTANT VOLUME - Multi	izone		HAP v3.04
Prepared by: EINHORN YAFFEE I			Page 1
********	******	*******	*****
1. SPACE SELECTION			
		Space Name	Qty
			=========
SPACES IN ZONE 1 (Zone 1)			
3. AHU 2-1 Multi-Purpose			
			==========
SPACES IN ZONE 2 (Zone 2)			
4. AHU 2-2 Stage	1		
SPACES IN ZONE 3 (Zone 3)	======		==========
SPACES IN ZONE 3 (Zone 3)			
5. AHU 2-3 Multi-Purpose	1		
			========

Name: AHU-3 PLC			12-30-94
Type: CONSTANT VOLUME - Sing	le Zone C	AV	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******	*****	*******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
=======================================	========		==========
SPACES IN ZONE 1 (Zone 1)			
6. AHU 3 Concourse			

	4 PLC TANT VOLUME - Multi y: EINHORN YAFFEE P			12-30-94 HAP v3.04 Page 1
	******		******	
1. SPACE S	ELECTION			
	e Name			
	ZONE 1 (Zone 1)			
	4-1 Music Room	1		
SPACES IN	ZONE 2 (Zone 2)			
8. AHU	4-2 TV Room	1		
SPACES IN	ZONE 3 (Zone 3)			
9. AHU	4-3 Mini Auditorium	1		
SPACES IN	ZONE 4 (Zone 4)			
10. AHU	4-4 Crafts Room	1		
SPACES IN	ZONE 5 (Zone 5)			
11. AHU	4-5 Reading Room	1		
SPACES IN	ZONE 6 (Zone 6)			
12. AHU	4-6 Office	1		
	ZONE 7 (Zone 7)			
	4-7 Offices	1		

Name: AHU-5 PLC Type: CONSTANT VOLUME - Sing	le Zone CA	V	12-30-94 HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
Space Name ====================================	Qty	Space Name	Qty

Name: AHU-6 PLC Type: CONSTANT VOLUME - Singl Prepared by: EINHORN YAFFEE P	RESCOTT	******	12-30-94 HAP v3.04 Page 1
1. SPACE SELECTION	Oty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)		=======================================	207
15. AHU 6 Travel / Kitchen	1		

Name: AHU-1 DDC			12-30-94
Type: CONSTANT VOLUME - S	ingle Zone CA	V	HAP v3.04
Prepared by: EINHORN YAFF	EE PRESCOTT		Page 1
******	******	*******	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)		
2. AHU-1 Assembly / T	ravel 1		

Name: AHU-2 DDC			12-30-94
Type: CONSTANT VOLUME - Mult	izone		HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTI	[Page 1
********	*****	********	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
=======================================	======	=======================================	========
SPACES IN ZONE 1 (Zone 1)			
2 Will 2 1 Males Dansen			
3. AHU 2-1 Multi-Purpose			
SPACES IN ZONE 2 (Zone 2)			=======================================
SPACES IN ZONE 2 (ZONE 2)			
4. AHU 2-2 Stage	1		
=======================================			========
SPACES IN ZONE 3 (Zone 3)			
5. AHU 2-3 Multi-Purpose	1		
	======		========

Name: AHU-3 DDC			12-30-94
Type: CONSTANT VOLUME - Singl	le Zone CAV		HAP v3.04
Prepared by: EINHORN YAFFEE I	PRESCOTT		Page 1
*******		******	_
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
		=======================================	~~ <i>y</i>
SPACES IN ZONE 1 (Zone 1)			
DIACED IN BONE I (BONE I)			
6. AHU 3 Concourse	1		
6. And 3 Concourse	1		

Name: AHU-4 DDC Type: CONSTANT VOLUME - Mult Prepared by: EINHORN YAFFEE **********************************	PRESCOTT	*******	12-30-94 HAP v3.04 Page 1
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
7. AHU 4-1 Music Room	1		
SPACES IN ZONE 2 (Zone 2)			
8. AHU 4-2 TV Room	1		
SPACES IN ZONE 3 (Zone 3)			
9. AHU 4-3 Mini Auditoriu	m 1		
SPACES IN ZONE 4 (Zone 4)			
10. AHU 4-4 Crafts Room	1		
SPACES IN ZONE 5 (Zone 5)	======:		=======================================
11. AHU 4-5 Reading Room			
SPACES IN ZONE 6 (Zone 6)			========
12. AHU 4-6 Office	1		
SPACES IN ZONE 7 (Zone 7)	*======		=========
13. AHU 4-7 Offices	1		=======================================

Name: AHU-5 DDC			12-30-94
Type: CONSTANT VOLUME - Sing	le Zone C	AV	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******	******	********	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
			===========
SPACES IN ZONE 1 (Zone 1)			
14. AHU 5 Acivity Room	1		

Name: AHU-6 DDC Type: CONSTANT VOLUME - Singl Prepared by: EINHORN YAFFEE F	RESCOTT	****	12-30-94 HAP v3.04 Page 1				

Space Name	Qty	Space Name	Qty				
SPACES IN ZONE 1 (Zone 1)	=========		=======				
15. AHU 6 Travel / Kitchen	1						

Plant: Cooling Plant		TANI INPO	I DAIA			12-30-94
Prepared By: EINHORN !	YAFFEE PRE	ESCOTT				Page 1
*******	*****	*****	*****	*****	******	******
PLANT NAME, CLASSIFICA	ATION & TY	PE				
Plant name Classification Type Type of simulation r Type of chiller	nodel	Cooling Air-Coo Compute A/C Rec	led Chill r-Generat	ler ced	ine	
AIR SYSTEM SELECTIONS						
Air System Name				Q۱	antity	
1. AHU-1 Baseline			. (SZ CZ	7A)	1	
2. AHU-2 Baseline					1	
3. AHU-3 Baseline 4. AHU-4 Baseline				AA)	1 1	
5. AHU-5 Baseline				AV)	1	
AIR-COOLED RECIPROCAT	ING CHILLE	ER DATA				
Estimated maximum co	_		NA			
Chiller capacity at Chiller input power			112.0 To			
Chiller configuration					s / Ckt.,	Unloaded
Is chilled water res			N			
Is hot gas bypass us % load for minimum w			N 20.0 %			
Crankcase heater kW	_		0.000 ki	√ .		
PUMP AND PIPING SYSTEM	ATA M					
		Pump	Efficie	ncies	Pump	Piping
Pump or						Gain/Loss
Piping System	(F')	(ft wg)	(で)	(ぎ) 	(kW)	(%)
Chilled Water	10.0	54.00	80.0	89.0	3.84	5.0

PLANT NAME, CLASSIFICATION & TYPE Plant name: Heating Plant - Baseline Classification: Heating Type: Hot Water Boiler
Plant name: Heating Plant - Baseline Classification: Heating Type: Hot Water Boiler
AIR SYSTEM SELECTIONS
Heating Coil Category
Air System Name Pre-Heat Central Terminal Zone
1. AHU-1 Baseline 1 - 1
2. AHU-2 Baseline 1
3. AHU-3 Baseline 1 - 1
4. AHU-4 Baseline 1
5. AHU-5 Baseline 1 - 1 6. AHU-6 Baseline 1 - 1
6. AHU-6 Baseline
HOT WATER BOILER DATA
Estimated maximum heating load: 1425.6 MBH Gross output at design: 1339.0 MBH Energy input at design: 1575.0 MBH Overall efficiency at design: 85.0 % Fuel or energy type: Nat. Gas Combustion air blower kW: 0.685 kW
BOILER PART-LOAD PERFORMANCE DATA
% Load Overall Eff. (%) % Load Overall Eff. (%)
90 85.0 40 85.0
80 85.0 30 85.0
70 85.0 20 85.0
60 85.0 10 85.0
50 85.0 0 0.0
PUMP AND PIPING SYSTEM DATA
Pump Efficiencies Pump Piping
Pump or Delta-T Head Mech Elec Power Gain/Loss
Piping System (F) (ft wg) (%) (%W) (%)
Hot Water 20.0 48.00 75.0 89.0 1.81 5.0

it should be included as a line load sometime C-80 in the import. Where should no hours

Plant: Cooling Plant - PLC 12-30-94 Prepared By: EINHORN YAFFEE PRESCOTT Page 1 ************************************								
PLANT NAME, CLASSIFICATION & TYPE Plant name: Cooling Plant - PLC Classification: Cooling Type: Air-Cooled Chiller Type of simulation model: Computer-Generated Type of chiller: A/C Reciprocating								
AIR SYSTEM SELECTIONS								
Air System Name	Ту	pe Quai	ntity					
7. AHU-1 PLC	(S(S	Z CAV) Z CAV) Z CAV)	1 1 1 1					
Estimated maximum cooling load: NA Chiller capacity at design: 112.0 Tons Chiller input power at design: 1.200 kW/Ton Chiller configuration: Mult. Compressors / Ckt., Unloaded Is chilled water reset used? N Is hot gas bypass used? N % load for minimum unloading: 20.0 % Crankcase heater kW								
PUMP AND PIPING SYSTEM DATA								
Piping System (F) (Pump Effi Head Mec Et wg) (%	ciencies th Elec	Pump					
	54.00 80.		3.84	5.0				

	<pre>ing Plant - PLC : EINHORN YAFFEE PRESCO' ************************************</pre>		******	*****	08-15-95 Page 1
PLANT NAME,	CLASSIFICATION & TYPE				
Plant nam Classific Type	e: Hea	ating Water Boi	ler		
AIR SYSTEM	SELECTIONS				
		He Pre-Heat	ating Coil Central	Category	_
7. AHU-1			1		1
8. AHU-2	PLC		1	-	-
9. AHU-3	PLC		1	-	1
10. AHU-4	PLC		1	-	-
11. AHU-5			1	-	1
	PLC		1	-	1
Gross out Energy in Overall e Fuel or e	maximum heating load put at design put at design fficiency at design nergy type n air blower kW	.: 1339.0 .: 1575.3 .: 85.0 .: Nat. Gas	MBH MBH %		
BOILER PA	RT-LOAD PERFORMANCE DATA	Ā			
	verall Eff. (%) % Loa				
	85.0	40 8			
90 80 70	85.0 85.0	40 8 30 8	5.0		
90 80 70 60	85.0 85.0 85.0 85.0	40 8 30 8 20 8	5.0 5.0 5.0		
90 80 70	85.0 85.0 85.0	40 8 30 8 20 8 10 8	5.0 5.0 5.0 5.0 5.0		
90 80 70 60 50 	85.0 85.0 85.0 85.0 85.0	40 8 30 8 20 8 10 8	5.0 5.0 5.0 5.0 0.0		
90 80 70 60 50 	85.0 85.0 85.0 85.0 85.0 85.0 PING SYSTEM DATA	10 8 30 8 20 8 10 8 0 Pump Effice Head Mech	5.0 5.0 5.0 5.0 0.0 	Pump Power (kW)	Piping Gain/Loss (%)

Plant: Cooling Plant - DDC Prepared By: EINHORN YAFFEE PRESCOTT ***********************************	12-30-94 Page 1 *********
Plant name: Cooling Plant Classification: Cooling Type: Air-Cooled Chil Type of simulation model: Computer-Generative of Chiller: A/C Reciprocations	ller ated
AIR SYSTEM SELECTIONS	
	Quantity
13. AHU-1 DDC	1 CAV) 1 1
Estimated maximum cooling load NA Chiller capacity at design 112.0 Chiller input power at design Mult. Composition M	kW/Ton pressors / Ckt., Unloaded %
PUMP AND PIPING SYSTEM DATA	
Piping System (F) (ft wg) (%)	Elec Power Gain/Loss
Chilled Water 10.0 54.00 80.0	89.0 3.84 5.0

Plant: Heating Plant Prepared By: EINHORN ************************************	YAFFEE PRI		*****	******	*****	08-15-95 Page 1
PLANT NAME, CLASSIFIC		YPE				
Plant name Classification Type		: Heatin	g ter Boil	.er		
AIR SYSTEM SELECTIONS						
Air System Name		P	Hea re-Heat	ting Coil Central	Termina	
13. AHU-1 DDC		 .	_	1	-	1
14. AHU-2 DDC			-	1	-	_
15. AHU-3 DDC			-	1	_	1
16. AHU-4 DDC			-	1	-	-
17. AHU-5 DDC				1	-	1
18. AHU-6 DDC				1	-	1
Estimated maximum h Gross output at des Energy input at des Overall efficiency Fuel or energy type Combustion air blow	ignat designer kW	: : : 	1408.7 1339.0 1575.3 85.0 at. Gas 0.685	MBH MBH %		
% Load Overall Eff			overall		-	
	- 12/					
90 85.0		40	85	5.0		
80 85.0		30		5.0		
70 85.0		20				
60 85.0		10				•
50 85.0 PUMP AND PIPING SYSTE		0	C 			
						Piping
Pump or	Delta-T		Mech		Power	
Piping System				(%)		(%)
Hot Water	20.0	48.00	75.0	89.0	1.81	5.0

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BUILDING INPUT DATA

Prepared by: HAP v3.04				*****	******	01-06-95 Page 1
BUILDING NAME			ilding 200 -		ne 	
PLANT SELECTION	NC					
Plant Nar					Quanti	_
2. Heating D	Plant -	Baseli	ne (A/ ne (HW	BOILE	R) 1	
MISCELLANEOUS	ELECTR	IC POWE	R USE			
			Max. Powe	r Use		
Reference Name				(kW)	Schedule	Name
Empty				0.0	NA	
Empty				0.0	NA	
Empty				0.0	NA NA	
						
MISCELLANEOUS						
			Conversion			
Name	Type	Units	kBTU/Units	Use		
Empty		THM				
Empty	NG		100.0000		NA	
Empty	NG				NA	
Empty	NG	THM	100.0000	0.0	NA	
Fuel Types: No	G=Nat.G	as FO=		Propan		Htg
ELECTRIC RATE						
Electric rate Average built	e		: Ft. Bel			\$/kWh
FUEL RATES						
			: Washing			
Propane Remote sourc Remote sourc	e heati	ing	: Ft. Bel	lvoir I	District S	team
MISCELLANEOUS	DATA					
Additional b	uilding	floor	areag efficiency.		:	4854.0 sqft 100.00 %

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BUILDING INPUT DATA

			BUILDING INPU	JT DATA	Į	
Prepared by:	EINHORN	YAFFEE	PRESCOTT			01-06-95
HAP v3.04						Page 1
					*******	*******
			ilding 200 -			
PLANT SELECT						
Plant Na					_	
					e Quantity	
			(A/		.r.ਵਰ) 1	
			(HW			
MISCELLANEOU	S ELECTR	IC POWE	R USE			
			Max. Powe	r Use		
Reference Na	me			(kW)	Schedule Name	
				-		
Empty				0.0	NA	
Empty				0.0	NA	
Empty				0.0	NA	
Empty				0.0	NA	
MISCELLANEOU	S FUEL U	SE				
			Conversion		Schedule Name	
Name			KBTU/UNICS			
Empty	NG		100.0000			
Empty	NG		100.0000		NA	
Empty	NG	THM			NA	
Empty	NG		100.0000	0.0	NA	
			. 			
Fuel Types:	NG=Nat.G	as FO=	Fuel Oil PR	Propar	ne RH=Rmt Htg	
			. 			
ELECTRIC RAT	E					
				lvoir E	Equivalent \$/kWh	
Average bui	lding po	wer fac	ctor.: NA			
FUEL RATES						
Natural cas					as Rate Schedule :	2
Fuel oil				gcon G	as Race benedure.	2
Propane						
Propane	ce heati	na	None	lvoir 1	District Steam	
Remote sour				LVOII .	Diborico bocam	
					•	
MISCELLANEOU	S DATA					
Additional	building	floor	area		: 4854.0	sqft
Source elec	tric ger	nerating	g efficiency.		: 100.00	용

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BUILDING INPUT DATA

Prepared by: HAP v3.04			PRESCOTT				01-06-99 Page :
BUILDING NAME	Ξ	: Bu	ilding 200 -				
PLANT SELECT							
Plant Na	ame			Type	Quanti	ity	
5. Cooling 6. Heating	Plant - Plant -	DDC	(A/	C CHIL	LER) 1 R) 1		
MISCELLANEOUS			R USE				
			Max. Powe				
Reference Nar					Schedule	Name	
Empty				0.0	NA		
Empty				0.0	NA		
Empty				0.0	NA NA		
Empty							
MISCELLANEOUS							
			Conversion				
Name	Type	Units	kBTU/Units	Use	Schedule	Name	
Empty	NG		100.0000	0.0	NA		
Empty	NG	THM	100.0000	0.0			
Empty Empty	NG NG		100.0000				
Fuel Types: 1	NG=Nat.G 	as FO=	Fuel Oil PR		le RH=Rmt		
ELECTRIC RAT	E						
Electric rate Average buil	te Iding po	wer fac	: Ft. Bel	Lvoir E	quivaient	\$/KWN	
FUEL RATES							
Natural gas			: Washing				
Fuel oil			: None				
Propane			: None	lucir I	Nistriat S	team	
Remote sour	ce cooli	.ng	: Ft. Bel				
MISCELLANEOU	S DATA						
Additional	building	floor	areag efficiency.		:	4854.0	sqft %
Source erec	ger			·			

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BUILDING 219

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12-30-94

HAP v3.04 Page 1 of 1

TABLE 1. SIMULATION WEATHER DATA DESIGN PARAMETERS

-	·	
	City:	Washington
	Location:	Dist. of Columbia
	Type of Data:	Typical Meteorological Year
	Latitude:	38.9 deg
	Longitude:	77.0 deg
	Elevation:	14.0 ft
*	Average Ground Reflectivity:	0.20
	Local Time Zone (GMT +/- N hours):	5.0 hours

^{*} Daylight Savings Time Considered.....? N

TABLE 2. DRY-BULB TEMPERATURE STATISTICS (F)

Month	Absolute Maximum	Average Maximum	Average	Average Minimum	Absolute Minimum	
January February March April May June July	60.4 62.1 75.5 85.5 91.9 93.5 91.0	39.3 42.8 53.9 65.7 73.3 80.8 84.9	30.7 33.1 43.3 55.0 63.5 70.0 75.9	21.0 22.9 32.4 44.3 53.8 58.8 66.5	-1.9 7.5 17.1 31.2 40.5 48.8 55.8	
August September October November December	96.8 91.6 84.7 75.7 59.0	85.1 79.3 67.5 56.4 42.7	74.3 69.3 56.8 46.6 36.9	64.5 60.0 46.7 35.7 30.9	49.6 46.5 23.4 17.3 20.5	

TABLE 3. DAILY TOTAL SOLAR RADIATION STATISTICS

ý,

	[Dai:	ly Total So	olar]	[Daily	Clearness 1	Number]
		(BTU/sqft)		(Di	mensionles	s)
Month	Maximum	Average	Minimum	Maximum	Average	Minimum
						

MOTICIT	Maximum	Average	PILITAMOM	naximam	Average	TITIIT III CIII
January	1043.4	609.1	137.7	0.648	0.430	0.107
February	1448.6	815.5	79.9	0.685	0.433	0.048
March	1861.2	1183.4	211.6	0.680	0.473	0.094
April	2371.0	1484.8	247.6	0.717	0.479	0.079
May	2579.4	1712.0	355.4	0.711	0.487	0.104
June	2551.8	1890.8	515.8	0.697	0.514	0.140
July	2398.3	1714.6	629.5	0.657	0.478	0.171
August	2378.9	1696.2	708.2	0.694	0.522	0.227
September	1943.6	1307.6	258.0	0.674	0.482	0.094
October	1546.1	977.2	92.6	0.656	0.469	0.045
November	1143.4	672.4	129.4	0.647	0.437	0.094
December	803.2	488.0	73.1	0.618	0.382	0.057

Notes: * All solar data is daily total flux on a horizontal surface.

^{* =} User-defined design parameters. All other values are fixed.

^{*} Clearness number is (Daily Total Solar)/(Extraterrestrial Solar) Values between 0.70 and 0.80 represent clear conditions.

CALENDAR DATA

Calandar	Name: Baseline	f	Day Timo Aggignments				
Carelluar	Name: baseline		Day Type Assignments Monday = Weekday				
January	first is on: Saturday	Tuesday = Weekday					
		Wednesday = Weekday Thursday = Weekday					
	Day Type Names						
	Day Type 1 = Weekday	j	Friday = Weekday				
	Day Type 2 = Saturday	İ	Saturday = Saturday				
	Day Type 3 = Sunday	ĺ	Sunday = Sunday				
			Holiday = Saturday				

SCHEDULE DATA

					LE DA	ľA						
Prepared By: 1 HAP v3.04	EINHO	RN YAI	FFEE I	PRESCO	TTC					Dags	12-3	
MAP V3.U4	****	*****	****	****	****	****	*****		· * * * * ·	Page		
Schedule Name								cly Pe				
Schedule Name	. FEO) I C					11041	-		-ages		
Hour>	00	01	02	03	04	05	06	07	08	09	10	11
DECTON DAY				 I 0	1 0				 - 0	 100	1100	1100
DESIGN DAY	0	0	0 0	0	0	0	0	0	50 10	100 25	100	100
Weekday	0	[0 0	0 0	1 0 1 0	0 0	0 0	l 0	0	1 0	0	40 0	50
Saturday	0	l 0	0	l 0	l 0	1 0	1 0	0	l 0	0	10	0
Sunday											1 10	
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	75	50	0
Weekday	60	60	50	40	40	40	50	50	50	50	50	0
Saturday	10	50	50	50	50	50	50	50	50	50	50	0
Sunday	40	50	50	50	50	50	25	0	0	0	0	0
************* Schedule Name	***** : Lig	***** hts	****	****	****	****	Hou	cly Pe	ercen	***** tages	****	****
Hour>	 00	01	02	03	04	05	 06	 07	08	09	10	11
				 -				· 				
DESIGN DAY	25	25	25	25	25	25	25	50	75	100	100	100
Weekday	25	25	25	25	25	25	25	50	75	100	100	100
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	25	25
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	50	25	25	25	25	25	25
Weekday	100	100	100	100	100	50	25	25	25	25	25	25
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday ********	25	25	25	25	25	25	25	25	25	25	25	25
Schedule Name	: Peo	ple A	udito:	rium			Hou:	rly Po	ercen	tages		
Hour>	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	1 0	l 0	l 0	1 0	1 0	1 0	l 0	0	50	100	100	100
Weekday	0	0	0	0	0	0	0	0	10	25	25	25
Saturday	0	0	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0	10	25
							1 20	1 10	1 22	1 01	1 22	1 22
Hour>	12	13	14	15 	16 	17		19 		21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	75	50	0
Weekday	25	25	25	25	25	25	25	25	25	50	50	50
Saturday	10	50	50	50	50	50	50	50	50	50	50	0
Sunday	40	50	50	50	50	50	25	0	0	0	0	0
******	****	****	****	****	****	****	****	****	****	****	****	****

SCHEDULE DATA

Prepared By: 3	EINHO					****	****	****	****	Page	12-3 2 0	f 2
Schedule Name: Lights - Auditorium Hourly Percentages												
Hour>	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY Weekday Saturday Sunday	15 15 15 15	15 15 15 15	15 15 15 15	15 15 15 15	15 15 15 15	15 15 15 15	15 15 15 15	15 15 15 15	50 10 15 15	100 100 15 15	100 100 15 15	100 100 15 100
Hour>	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY Weekday Saturday Sunday	100 100 15 100	100 100 100	100 100 100 100	100 100 100 100	100 100 100 100	100 100 100 100	100 100 100 25	100 100 100 15	100 100 100 15	75 50 100 15	50 50 100 15	15 50 15 15

WALL CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE PRES HAP v3.04 ************		****	*****]	2-30-94 Page 1
WALL TYPE 1: (CUSTOM WALL)					
Description: Brick Ca Absorptivity: 0.900	vity Wall				
Layer Description					
Inside surface resistance 1/2-in (13 mm) gypsum plaster 8-in (203 mm) LW concrete block 4-in (102 mm) face brick Outside surface resistance	8.00 4.00	45.0 38.0 125.0	0.32 0.20 0.22	2.02 0.43 0.33	25.3 41.7
Totals	12.50				68.9
Thickness: in Den R-value : (hr-sqft-F)/BTU Spe	sity: lb/cu cific Heat:		_	nt: lb/s	sqft

ROOF CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE HAP v3.04	PRESCOTT				2-30-94 Page 1
******************	******	*****	*****		
ROOF TYPE 1: (CUSTOM ROOF)					
Description: Shing Absorptivity: 0.90					
Layer Description	Thickness	Density	Spec.Ht	R-Val	Weight
Inside surface resistance	-	-	-	0.69	-
3/4" Acoustic Ceiling Tile	0.75	18.0	0.14	1.89	1.1
1/2-in (13 mm) plywood	0.50	34.0	0.29	0.62	1.4
Asphalt shingles	0.13	70.0	0.30	0.43	0.7
Outside surface resistance		-			-
Totals	1.38			3.96	3.3
Thickness: in R-value : (hr-sqft-F)/BTU	Density: lb/cu	ft	Weigh		sqft

WINDOW TYPE CONSTRUCTIONS

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94
HAP v3.04	Page 1
***************	*****
WINDOW TYPE 1: (SIMPLE WINDOW)	
Window Description: Single Pane (By sqft)	
Height 1.00 ft	
Width 1.00 ft	
Overall U-value: 1.110 BTU/hr/sqft/F	
Overall Shade Coeff: 0.870	

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94
HAP v3.04	Page 1
***********	*******
GENERAL SCHEDULES	
Name: East Perimeter - 1st Flr Lighting.	
Floor Area: 1550.0 sqft Task Ligh	hts.: Lights
Building Weight.: 70.0 lb/sqft People	: People
Windows Shaded? N Equipment	t: People
Partitions Used.? N Misc. Ser	ns: People
LIGHTING Misc. Lat	tent: People
Overhead Fixture: Recessed INFILTRATE	ION
Lamp Wattage: 3.00 W/sqft Cooling	: 0.00 CFM/sqft
	: 0.00 CFM/sqft
Task Lighting: 0.00 W/sqft Typical	: 0.10 CFM/sqft
PEOPLE When Fan	On.? Y
Occupancy: 200.0 sqft/per FLOOR	
	:Above Conditioned Space
Sensible 245.0 BTU/hr	
Latent 205.0 BTU/hr	
OTHER LOADS	
Equipment: 1.50 W/sqft	
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
WALL Gross Area WALL WINDOW	WINDOW
Exp (sqft) Type Type Qty Shade	Type Qty Shade Doors?
E 1290.0 1 1 810 -	1 0 - N
ROOF Slope Gross Area ROOF SKYLIGHT	
Exp (deg) (sqft) Type Type Qty	
Exp (deg) (bqtt) Type Type 201	
HOR - 984.0 1 1 0	
No partition data for this space.	=======================================
No partition data for this space.	

Prepared by: EINHOF HAP v3.04							12-30-9 Page
**************************************	Perimeter 850.0 70.0 N N Recessed 3.00 1.00 0.00 200.0 Office Wor 245.0 205.0	- 1st Fl sqft lb/sqft W/sqft W/sqft sqft/per rk BTU/hr BTU/hr W/sqft	Lighting Task Lig People Equipmer Misc. Se Misc. La INFILTRAT Cooling. Heating. Typical. When Far FLOOR	ghts.: http://discourage.com/	Lights Lights People People People	5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	**************************************
Misc. Latent:		BTU/hr =======		=====	====:	======	=======================================
WALL Gross Area Exp (sqft)		WINDO			INDOW Qty		Any Doors?
S 480.0 N 430.0		1 216	5 - O -	1	0	-	N
======================================					=====	======	=======================================

Prepared by: EINHORN YAFFEE	PRESCOTT				12-30-94
HAP v3.04	*****	******	*****	******	Page 1
GENERAL Name: West Perimeter Floor Area: 1350. Building Weight: 70. Windows Shaded?	- 1st Flr) sqft	SCHEDULES Lighting Task Lig People. Equipmen Misc. Se	3 J: Light Jhts.: Light	e e e	*****
Overhead Fixture: Recessed Lamp Wattage: 3.0 Ballast Mult: 1.0 Task Lighting: 0.0 PEOPLE Occupancy: 200. Activity Level: Office W Sensible: 245. Latent: 205. OTHER LOADS Equipment: 1.5	0 W/sqft 0 W/sqft 0 sqft/per 0 sqft/per 0 BTU/hr 0 BTU/hr	INFILTRAT Cooling Heating Typical When Far FLOOR	FION:	0.00 CF 0.00 CF 0.10 CF Y	M/sqft M/sqft
Misc. Latent: 0.	BTU/hr BTU/hr				
WALL Gross Area WALL Exp (sqft) Type	WINDO	W	WINDOW Type Qty		Any Doors?
W 1530.0 1	1 144	-	1 0	-	N
ROOF Slope Gross Area Exp (deg) (sqft)	!		 		
HOR - 664.0	- 1	1 0			
No partition data for this					

Prepared by: EINHO	RN YAFFEE	PRESCOTT				12-30-9
HAP v3.04						Page
******	*****	******	*****	******	******	****
GENERAL			SCHEDULES	}		
Name: North	Perimeter	- 1st Fl	Lighting	[: Li	lghts	
Floor Area:			-		•	
Building Weight.:		lb/sqft	People	: Pe	eople	
Windows Shaded?			Equipmen		-	
Partitions Used.?	N		Misc. Se			
LIGHTING			Misc. La		eople	
Overhead Fixture:			INFILTRAT			
Lamp Wattage:		W/sqft				
Ballast Mult:			Heating.	:		-
Task Lighting:	0.00	W/sqft	sqft Typical: 0.10 CFM/sqft			
PEOPLE			When Far	on.?	Y	
Occupancy:						
Activity Level:	Office Wo:	rk	Туре	:Abo	ove Conditi	oned Space
Sensible:		•				
Latent:	205.0	BTU/hr				
OTHER LOADS						
Equipment:	1.50	W/sqft				
Misc. Sensible:	0.0	BTU/hr				
Misc. Latent:		•				
 NALL Gross Area					 vdow	Any
Exp (sqft)						
	TAbe				ery bhade	
110.0	1 1	1 () -	1	0 -	N
		=======				========
No roof or door da		-				
				.======		========
No partition data	-	-				

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94
HAP v3.04	Page 1
*********	**********
GENERAL	SCHEDULES
	Lighting: Lights
Floor Area: 10861.0 sqft	
Building Weight.: 70.0 lb/sqft	
Windows Shaded? N	Equipment: People
Partitions Used.? N	Misc. Sens: People
LIGHTING	Misc. Latent: People
Overhead Fixture: Recessed	INFILTRATION
Lamp Wattage: 3.00 W/sqft	
Ballast Mult: 1.00	
Task Lighting: 0.00 W/sqft	
PEOPLE	When Fan On.?
Occupancy: 200.0 sqft/per	r FLOOR
Activity Level: Office Work	Type:Above Conditioned Space
Sensible 245.0 BTU/hr	
Latent 205.0 BTU/hr	
OTHER LOADS	
Equipment: 1.50 W/sqft	
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
No external wall or window data for t	-
ROOF Slope Gross Area ROOF S	
Exp (deg) (sqft) Type Type	- :
	1 0 1
HOR - 2520.0 1	1
No partition data for this space.	
_	

Prepared by: EINHORN YAFFEE PRES	SCOTT 12-30-94
HAP v3.04	Page 1
********	************
GENERAL	SCHEDULES
Name: East Perimeter - 2r	nd Flr Lighting: Lights
Floor Area: 1530.0 sqf	ft Task Lights.: Lights
Building Weight.: 70.0 lb/	/sqft People: People
Windows Shaded? N	Equipment: People
Partitions Used.? N	Misc. Sens: People
LIGHTING	Misc. Latent: People
Overhead Fixture: Recessed	INFILTRATION
Lamp Wattage: 3.00 W/s	sqft Cooling: 0.00 CFM/sqft
	Heating: 0.00 CFM/sqft
Task Lighting: 0.00 W/s	sqft Typical: 0.10 CFM/sqft
PEOPLE	When Fan On.? Y
Occupancy: 200.0 sqf	ft/per FLOOR
Activity Level: Office Work	Type:Above Conditioned Space
Sensible: 245.0 BTU	
Latent 205.0 BTU	U/hr
OTHER LOADS	
Equipment: 1.50 W/s	sqft
Misc. Sensible: 0.0 BTU	U/hr
Misc. Latent: 0.0 BTU	U/hr
	WINDOW WINDOW Any
Exp (sqft) Type Typ	pe Qty Shade Type Qty Shade Doors?
E 1490.0 1 1	1 232 - 1 0 - N
	=======================================
	OF SKYLIGHT
Exp (deg) (sqft) Tyr	pe Type Qty
HOR - 1530.0	1 1 0
No partition data for this space	======================================

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Prepared by	: EINHO	RN YAFFEE	PRESCO'	TT					12-30-94
HAP v3.04									Page 1
******	*****	*****	*****	****	*****	*****	****	****	*****
GENERAL				S	CHEDULES	5			
Name	: South	Perimeter	- 2nd	Fl :	Lighting	1:	Light	S	
Floor Area					Task Lig				
Building W					People.				
Windows Sh					Equipmer				
Partitions	Used.?	N			Misc. Se				
LIGHTING					Misc. La		_		
Overhead F	ixture:	Recessed			NFILTRAT				
Lamp Watta							(0.00 0	FM/sqft
Ballast Mu	-		-		_				:FM/sqft
Task Light					_				:FM/sqft
PEOPLE	1119 · · · ·	0.00	, 541		When Far			Y Y	.111, 0410
Occupancy.		200 0	sqft/			. 0		•	
Activity L						<u>.</u> Δ	bove (Condit	ioned Space
Sensible			BTU/h		-150			0011410	zonou opuco
Latent									
OTHER LOADS		203.0	210,11	-					
Equipment.		1 50	W/saf	+					
Misc. Sens									
Misc. Late			BTU/h						
=========					======	======	=====	=====	
WALL Gross				INDOW			INDOW		Any
Exp (Type							1 -
(-12						
-	120.0	1 1	1	288	-	1	0	-	N
ROOF Slope			ROOF			====== 	=====		
Exp (deg)		(sqft)			Qty	 			
HOR -		1200.0		1					
No postitio	====== n data	for this s	===== D2C6	====	======		=====	=====	=======================================
No partitio									=======================================

Prepared by: EINHORN YAFFE HAP v3.04		12-30-94 Page 1
**************************************	O lb/sqft People: Peopl N Equipment: Peopl N Misc. Sens: Peopl Misc. Latent: Peopl INFILTRATION O W/sqft Cooling: Heating: When Fan On.?	**************************************
Latent: 205 OTHER LOADS Equipment: 1. Misc. Sensible.: 0 Misc. Latent: 0	0 BTU/hr 0 BTU/hr 50 W/sqft 0 BTU/hr 0 BTU/hr	
WALL Gross Area WALL	WINDOW WINDOW Type Qty Shade Type Qty	N Any
W 1600.0 1	1 162 - 1 0	- N
ROOF Slope Gross Area Exp (deg) (sqft)	Type Type Qty	
HOR - 1632.0 No partition data for this		

Prepared by: EINHORN HAP v3.04			*****	*****	*****	12-30-94 Page 1
GENERAL Name: North I Floor Area: Building Weight: Windows Shaded.? Partitions Used.? LIGHTING Overhead Fixture: I Lamp Wattage: Ballast Mult: Task Lighting:	Perimeter 792.0 70.0 N N Recessed 3.00 1.00	- 2nd Fl sqft lb/sqft W/sqft	SCHEDULES Lighting Task Lig People. Equipmen Misc. Se Misc. La INFILTRA Cooling Heating Typical	g: Ligh ghts.: Ligh: Peop nt: Peop ens.: Peop atent: Peop TION:	ts ts le le le 0.00 CF 0.00 CF 0.10 CF	"M/sqft "M/sqft
PEOPLE Occupancy: Activity Level: Sensible: Latent: OTHER LOADS Equipment: Misc. Sensible: Misc. Latent:	245.0 245.0 205.0 1.50 0.0 0.0	BTU/hr BTU/hr W/sqft BTU/hr BTU/hr	Type		Y Conditi	oned Space
WALL Gross Area	WALL	WIND	OW	WINDO Type Qty		Any Doors?
и 800.0	1	_	0 -	1 0		и
ROOF Slope Gross	s Area (sqft)	ROOF S	KYLIGHT pe Qty	 		
HOR -	792.0 ======= or this s	1 ======= pace.	1 0		=======	

Prepared by: EINHORN YAFFEE PRESCO	DTT 12-30-94
HAP v3.04	Page 1
********	*************
GENERAL	SCHEDULES
Name: Interior - 2nd Flr	Lighting: Lights
Floor Area: 5040.0 sqft	Task Lights.: Lights
Building Weight.: 70.0 lb/sc	Ift People: People
Windows Shaded? N	Equipment: People
Partitions Used.? N	Misc. Sens: People
LIGHTING	Misc. Latent: People
Overhead Fixture: Recessed	INFILTRATION
Lamp Wattage: 3.00 W/sqf	t Cooling: 0.00 CFM/sqft
Ballast Mult: 1.00	Heating: 0.00 CFM/sqft
Task Lighting: 0.00 W/sqf	ft Typical: 0.00 CFM/sqft
PEOPLE	When Fan On.?
Occupancy: 200.0 sqft/	
Activity Level: Office Work	Type:Above Conditioned Space
Sensible: 245.0 BTU/h	ır
Latent 205.0 BTU/1	nr
OTHER LOADS	
Equipment: 1.50 W/sqt	Ēt .
Misc. Sensible: 0.0 BTU/h	
Misc. Latent: 0.0 BTU/H	nr
No external wall or window data for	
ROOF Slope Gross Area ROOF	
Exp (deg) (sqft) Type	
HOR - 5040.0 1	•
The same that are detailed that are are	
No partition data for this space.	
=======================================	

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Prepared by: EINHORN YAFFEE PRESCOTT 12-30-9	94
HAP v3.04 Page	1
*****************	+ *
GENERAL SCHEDULES	
Name: Auditorium Lighting: Lights - Auditorium	
Floor Area: 8000.0 sqft Task Lights.: Lights - Auditorium	
Building Weight.: 70.0 lb/sqft People: People Auditorium	
Windows Shaded? N Equipment: People Auditorium	
Partitions Used.? N Misc. Sens: People Auditorium	
LIGHTING Misc. Latent: People Auditorium	
Overhead Fixture: Recessed INFILTRATION	
Lamp Wattage: 3.00 W/sqft Cooling: 0.00 CFM/sqft	
Ballast Mult: 1.00 Heating: 0.00 CFM/sqft	
Task Lighting: 0.00 W/sqft Typical: 0.10 CFM/sqft	
PEOPLE When Fan On.? Y	
Occupancy: 15.0 sqft/per FLOOR	
Activity Level: Seated at Rest Type:Slab On Grade	
Sensible: 230.0 BTU/hr Perimeter: 300.0 ft	
Latent: 120.0 BTU/hr Slab Floor Area: 8000.0 sqf	Ēt
OTHER LOADS Floor R-Value 2.40	
Equipment: 0.00 W/sqft Insulation R-value: 0.00	
Misc. Sensible: 0.0 BTU/hr	
Misc. Latent: 0.0 BTU/hr	
	==
WALL Gross Area WALL WINDOW WINDOW Any	
Exp (sqft) Type Type Qty Shade Type Qty Shade Doors?	
N 2460.0 1 1 0 - 1 0 - N	
N 2400.0	
1300.0	
5	
W 1300.0 1 1 0 - 1 0 - N	
Exp (deg) (sqft) Type Type Qty	
HOR - 8000.0 1 1 0	
=======================================	==

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Name: Fan Coil Units - Baseline	12-30-94
Type: TERMINAL UNITS - 2-Pipe Fan	
Prepared by: EINHORN YAFFEE PRESCO	TT Page 1
1. SYSTEM NAME AND TYPE	
Name Fan Coil Units	
Type : TERMINAL UNITS	
Number of Zones.: 8	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Supply Air:	55.0 F
Fan Cycled for Cooling?	N
Coil Bypass Factor HEATING SYSTEM DATA	0.100
Fan Cycled for Heating? OUTDOOR VENTILATION DATA	N
Common Ventilation System Used? SAFETY FACTORS	И
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor OUTDOOR VENTILATION DATA	0 %
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	0.0 CFM/person
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling (F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
	3.0
Zone Terminal Type	Fan Coil 0.25
<pre>Fan Total Static(in.wg.): Fan Efficiency(%):</pre>	54

Name: Fan Coil Units - Baseline Type: TERMINAL UNITS - 2-Pipe Fan Coils Prepared by: EINHORN YAFFEE PRESCOTT ***********************************	12-30-94 HAP v3.04 Page 2
4. SCHEDULE DATA	=======
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8	
Design Day	X X X X X X X X X X
Cooling Available During Unoccupied Period ? Y MONTHLY SCHEDULES JAN FEB MAR APR MAY JUN JUL AUG SEP OC	======== T NOV DEC
Terminal Heating XXX x xxx xxx	

	EM INPUT DATA			
Name: Interior 219 - Baseline	12-30-94			
Type: CONSTANT VOLUME - Single Zone	E CAV HAP v3.04			
Prepared by: EINHORN YAFFEE PRESCOTT Page 1				

1. SYSTEM NAME AND TYPE				
Name: Interior 219 -				
Type: CONSTANT VOLUME	s - Single Zone CAV			
Number of Zones.: 1				
=======================================				
2. SYSTEM DESCRIPTION				
	•••••			
COOLING SYSTEM DATA				
Is Central Cooling Used?	Y			
Supply Air:	12930.0 CFM			
Coil Bypass Factor:	0.100			
Fan Cycled for Cooling?	N			
Supply Air Reset:	Not Used			
HEATING SYSTEM DATA				
Is Central Heating Used?	Y			
Fan Cycled for Heating?	N			
	Not Used			
Supply Air Reset:	Not used			
OUTDOOR VENTILATION DATA	G			
Type of Control:	Constant Airflow Rate			
Design Ventilation Airflow:	3230.0 CFM			
Dampers Open During Unocc Per.:	N			
Damper Leak Rate:	2 %			
SUPPLY DUCT DATA				
Duct Heat Gain:	2 %			
Duct Leakage Rate:	5 %			
RETURN PLENUM DATA				
Is a Return Plenum Used?	N			
SUPPLY FAN DATA				
Fan Type:	Forward Curved			
Configuration:	Draw-Thru			
Fan Total Static:	2.00 in.wg.			
Fan Efficiency:	54 %			
RETURN FAN DATA				
Fan Type:	User Defined			
Fan Total Static:	0.25 in.wg.			
Fan Efficiency:	50 %			
OUTDOOR AIR ECONOMIZER				
Outdoor Economizer Type:	None			
PREHEAT COIL				
Preheat Coil Used?	N			
PRECOOL COIL				
Precool Coil Used?	N			
HUMIDIFICATION				
Humidification System Used?	N			
	11			
DEHUMIDIFICATION Dehumidification System Used 3	N			
Dehumidification System Used?	74			
VENTILATION HEAT RECLAIM	None			
Reclaim Unit Type:	None			
SAFETY FACTORS	0 %			
Sensible Cooling Factor:	0 %			
Latent Cooling Factor:	0 % 0 %			
Heating Factor:				
	=======================================			

Name: Interior 219 - Baseline		12-30-94
Type: CONSTANT VOLUME - Single Zon	HAP v3.04	
Prepared by: EINHORN YAFFEE PRESCO		Page 2
*********	******	*******
3. ZONE DATA		
ZONE	1 (Al	l Zones the Same)
T-Stat Occupied Cooling(F):	75.0	
Unoccupied Cooling(F):	85.0	
Occupied Heating(F):	70.0	
Unoccupied Heating(F):	55.0	
Throttling Range(F):	3.0	
Zone Heating Unit Type:	None	
Trip Temperature(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static(in.wg.):	-	
Fan Efficiency(%):	-	
Zone Terminal Type:	Diffuser	
Reheat Coil?	N	
Direct Exhaust Airflow(CFM):	0.0	
Direct Exhaust Fan kW(kW):	0.0	
=======================================		=======================================
4. SCHEDULE DATA		
=======================================		
		1 1 1 1 1 1 1 1 1 1 2 2 2 2 2
[0]1 2 3	4 5 6 7 8 9 0 1	234567890123
Design Day X X X X	x x x x x x x x	
Sunday X X X X X	x x x x x x x x x	
=======================================		
Cooling Available During Unoccupi		
		JUL AUG SEP OCT NOV DEC
Central Heating XXX XXX		
Central Cooling		

C-110

AIR SISI.	EM INPUL DATA
Name: Auditorium - Baseline	12-30-94
Type: CONSTANT VOLUME - Single Zon	e CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCO	

1 CYCERN NAME AND EXPE	
1. SYSTEM NAME AND TYPE	
Name Auditorium - B	aseline
Type CONSTANT VOLUM	E - Single Zone CAV
Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	**
Is Central Cooling Used?	Y
Supply Air:	30000.0 CFM
Coil Bypass Factor:	0.100
Fan Cycled for Cooling?	N
Supply Air Reset:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control	Constant Airflow Rate
Design Ventilation Airflow:	5000.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	•
	Forward Curved
Fan Type:	
Configuration:	Draw-Thru
Fan Total Static:	2.50 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used?	N
PRECOOL COIL	
Precool Coil Used?	Ŋ
HUMIDIFICATION	••
	N.
Humidification System Used?	И
DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %
_	

Name: Auditorium - Baseline	12-30-9	}4	
Type: CONSTANT VOLUME - Single Zone CAV	HAP v3.0)4	
Prepared by: EINHORN YAFFEE PRESCOTT Page 2			

3. ZONE DATA		_	
ZONE 1 (All Zones the Same	>)		
T-Stat Occupied Cooling(F): 75.0			
Unoccupied Cooling(F): 85.0			
Occupied Heating(F): 70.0			
Unoccupied Heating(F): 55.0			
Throttling Range(F): 3.0			
Zone Heating Unit Type None			
Trip Temperature(F):			
Design Supply Temperature(F):			
Fan Total Static(in.wg.):			
Fan Efficiency(%):			
Zone Terminal Type Diffuser			
Reheat Coil N			
Direct Exhaust Airflow(CFM): 0.0			
Direct Exhaust Fan kW(kW): 0.0			
		==	
4. SCHEDULE DATA			
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1	1 2 2 2 2	= = > t	
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 0	1 1 1 1		
0 1 2 3 4 3 0 7 0 9 0 1 2 3 4 3 0 7 0		 -	
Design Day X X X X X X X X	x x x x	x	
Weekday	xxxxxx	Χİ	
Saturday X X X X X X X X			
Sunday	x x x x x	Χİ	
	=======	==	
Cooling Available During Unoccupied Period ? Y			
MONTHLY SCHEDULES JAN FEB MAR APR MAY JUN JUL AUG SEP OC			
Central Heating XXX XXX XXX XXX	x xxx xx	x	
Central Cooling		İ	

Name: Fan Coil Units - PLC Type: TERMINAL UNITS - 2-Pipe Fan Prepared by: EINHORN YAFFEE PRESCO	
1. SYSTEM NAME AND TYPE	
Name: Fan Coil Units Type: TERMINAL UNITS Number of Zones.: 8	- 2-Pipe Fan Coils
=======================================	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Supply Air:	55.0 F
Fan Cycled for Cooling?	И
Coil Bypass Factor: HEATING SYSTEM DATA	0.100
Fan Cycled for Heating? OUTDOOR VENTILATION DATA	И
Common Ventilation System Used? SAFETY FACTORS	И
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor: OUTDOOR VENTILATION DATA	0 %
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	0.0 CFM/person
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling (F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
Zone Terminal Type: Fan Total Static(in.wg.):	Fan Coil 0.25
Fan Efficiency(%):	54

Name: Fan Coil Units - PLC Type: TERMINAL UNITS - 2- Prepared by: EINHORN YAFFE	Pipe Fan Coils	DATA 12-30-94 HAP v3.04 Page 2
4. SCHEDULE DATA		
		0 1 1 1 1 1 1 1 1 1
Design Day		X X X X X X X X X X
Cooling Available During U	Inoccupied Period	? N
MONTHLY SCHEDULES J	JAN FEB MAR APR MA	AY JUN JUL AUG SEP OCT NOV DEC
Terminal Heating X Terminal Cooling		

Name: Interior 219 - PLC Type: CONSTANT VOLUME - Single Zon Prepared by: EINHORN YAFFEE PRESCO	
1. SYSTEM NAME AND TYPE	
Name: Interior 219 - Type: CONSTANT VOLUM Number of Zones.: 1	PLC
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	
Is Central Cooling Used?	Y
Supply Air	
Coil Bypass Factor	0.100
Fan Cycled for Cooling?	N Not Used
Supply Air Reset HEATING SYSTEM DATA	NOC USEC
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	3230.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	N.
Is a Return Plenum Used? SUPPLY FAN DATA	И
1 dil 1/po	Forward Curved
Configuration:	
Fan Total Static:	2.00 in.wg.
Fan Efficiency RETURN FAN DATA	54 %
Fan Type:	User Defined
Fan Total Static:	0.25 in.wg.
Fan Efficiency:	50 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	M
Preheat Coil Used?	N
PRECOOL COIL Precool Coil Used?	N
HUMIDIFICATION	14
	И
Humidification System Used? DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %
=======================================	=======================================

Name: Interior 219 - PLC	12-30-94		
Type: CONSTANT VOLUME - Single Zone CAV			
Prepared by: EINHORN YAFFEE PRESCOTT			
*******	**********		
3. ZONE DATA			
ZONE	1 (All Zones the Same)		
T-Stat Occupied Cooling(F):	75.0		
Unoccupied Cooling(F):	85.0		
Occupied Heating(F):	70.0		
Unoccupied Heating(F):	55.0		
Throttling Range(F):	3.0		
Zone Heating Unit Type	None		
Trip Temperature(F):	-		
Design Supply Temperature(F):	-		
Fan Total Static(in.wg.):	-		
Fan Efficiency(%):	-		
Zone Terminal Type:	Diffuser		
Reheat Coil?	N		
Direct Exhaust Airflow(CFM):	0.0		
Direct Exhaust Fan kW(kW):	0.0		
=======================================			
4. SCHEDULE DATA			
	00000001111111111111112222		
01123	4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3		
Design Day			
Weekday			
Saturday			
Sunday			
=======================================			
Cooling Available During Unoccup			
	MAR APR MAY JUN JUL AUG SEP OCT NOV DEC		
Central Heating XXX XXX Central Cooling			

Name: Auditorium - PLC Type: CONSTANT VOLUME - Single Zone Prepared by: EINHORN YAFFEE PRESCO	
1. SYSTEM NAME AND TYPE	
Name: Auditorium - Pl Type: CONSTANT VOLUM! Number of Zones.: 1	
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	Y
Is Central Cooling Used?	30000.0 CFM
Supply Air	0.100
Coil Bypass Factor:	N
Fan Cycled for Cooling? Supply Air Reset	Not Used
HEATING SYSTEM DATA	110C 05ed
Is Central Heating Used?	Y
Fan Cycled for Heating?	N
Supply Air Reset:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	5000.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain:	2 %
Duct Leakage Rate:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used?	N
SUPPLY FAN DATA	Forward Curved
Fan Type:	Draw-Thru
Configuration: Fan Total Static:	0.90 in.wg.
Fan Efficiency:	54 %
RETURN FAN DATA	
Fan Type:	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type:	None
PREHEAT COIL	
Preheat Coil Used? PRECOOL COIL	N
Precool Coil Used?	N
HUMIDIFICATION	
Humidification System Used?	И
DEHUMIDIFICATION	
Dehumidification System Used?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type:	None
SAFETY FACTORS	
Sensible Cooling Factor:	0 %
Latent Cooling Factor:	0 %
Heating Factor:	0 %

AIR SYSTEM INPUT DATA Name: Auditorium - PLC Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT **********************************						IAP v Pag				
3. ZONE DATA										
ZONE T-Stat Occupied Cooling	(F): (F): (F): (F): (F): e(F):		75.0 85.0 70.0 55.0 None		l Zor	nes t	che	Same)		
Fan Efficiency	.(%):? CFM): (kW):		iffuser 0.0 0.0	ī) :=====	====:	====	===	====:		
			0 0 0 6 7 8	0 1 1	. 1 1	111	111		2 2	
Design Day				X X X X X X X X X	x x x x x x x x x	X X X X X X	x x x x x x	x x x x x x x x x	X X	
Cooling Available During U	noccu	pied =====	Period	? Y	====			.====	==== NOV	 DEC
Central Heating X: Central Cooling			xxx	(X XXX		 !	 !	xxx		XXX

Name: Fan Coil Units - DDC	12-30-94
Type: TERMINAL UNITS - 2-Pipe Far	
Prepared by: EINHORN YAFFEE PRESCO	Page 1
**********	**********
1. SYSTEM NAME AND TYPE	
Name Fan Coil Units	
Type TERMINAL UNITS	
Number of Zones.: 8	2 Tapo Tam Goldon
	=======================================
2. SYSTEM DESCRIPTION	
COOLING SYSTEM DATA	55.0 F
Supply Air	N
Coil Bypass Factor:	0.100
HEATING SYSTEM DATA	
Fan Cycled for Heating?	N
OUTDOOR VENTILATION DATA	
Common Ventilation System Used?	N
SAFETY FACTORS	0 9
Sensible Cooling Factor:	0 % 0 %
Latent Cooling Factor: Heating Factor	0 %
OUTDOOR VENTILATION DATA	
Type of Control:	Constant Airflow Rate
Design Ventilation Airflow:	
3. ZONE DATA	
ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling(F):	75.0
Unoccupied Cooling(F):	85.0
Occupied Heating(F):	70.0
Unoccupied Heating(F):	55.0
Throttling Range(F):	3.0
<pre>Zone Terminal Type: Fan Total Static(in.wg.):</pre>	Fan Coil 0.25
Fan Efficiency(%):	54

Type: TERMINAL UNITS - 2-Pipe Fan Coils Prepared by: EINHORN YAFFEE PRESCOTT ***********************************	HAP v3.04 Page 2
4. SCHEDULE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1	2 2 2 2
Design Day.	
Cooling Available During Unoccupied Period ? N	
MONTHLY SCHEDULES JAN FEB MAR APR MAY JUN JUL AUG SEP OC	NOV DEC
Terminal Heating XXX XXX XXX XXX	XXX XXX

Name: Interior 219 - DDC Type: CONSTANT VOLUME - Single Zone Prepared by: EINHORN YAFFEE PRESCOT	T Page 1 ************************************
	=======================================
2. SYSTEM DESCRIPTION	
	Y 12930.0 CFM 0.100 N Not Used Y N Not Used Constant Airflow Rate 3230.0 CFM N 2 % 5 % N Forward Curved Draw-Thru 2.00 in.wg. 54 % User Defined 0.25 in.wg. 50 % Integrated Enthalpy 95.0 F 0.0 F N N N
DEHUMIDIFICATION	N
Dehumidification System Used? VENTILATION HEAT RECLAIM Reclaim Unit Type:	None

Name: Interior 219 - DDC Type: CONSTANT VOLUME - Single Zone CAV Prepared by: EINHORN YAFFEE PRESCOTT **********************************	12-30-94 HAP v3.04 Page 2
2. SYSTEM DESCRIPTION (CONTINUED)	
SAFETY FACTORS Sensible Cooling Factor: Latent Cooling Factor: Heating Factor:	0 % 0 % 0 %
3. ZONE DATA	
T-Stat Occupied Cooling(F): 75.0 Unoccupied Cooling(F): 85.0 Occupied Heating(F): 70.0 Unoccupied Heating(F): 55.0 Throttling Range(F): 3.0 Zone Heating Unit Type: None Trip Temperature(F): - Design Supply Temperature(F): - Fan Total Static(in.wg.): - Fan Efficiency(%): - Zone Terminal Type: Diffuser Reheat Coil? N Direct Exhaust Airflow(CFM): 0.0 Direct Exhaust Fan kW(kW): 0.0	(All Zones the Same)
0 1 2 3 4 5 6 7 8 9	1 1 1 1 1 1 1 1 1 2 2 2 2 0 1 2 3 4 5 6 7 8 9 0 1 2 3
	X X X X X X X X X X
Cooling Available During Unoccupied Period ?	N
	JUN JUL AUG SEP OCT NOV DEC
Central Heating XXX XXX XXX XXX Central Cooling XXX	

Name: Auditorium - DDC	EM INPUI DATA	12-30-94
Type: CONSTANT VOLUME - Single Zone	HAP v3.04	
Prepared by: EINHORN YAFFEE PRESCO	Page 1	

1. SYSTEM NAME AND TYPE		
Name Auditorium - Di	DC	
Type CONSTANT VOLUM	E - Single Zo	one CAV
Number of Zones.: 1		
		=======================================
O GVOTEM DECORIDETON		
2. SYSTEM DESCRIPTION		
COOLING SYSTEM DATA		
Is Central Cooling Used?	Y	
Supply Air	30000.0	CFM
Coil Bypass Factor:	0.100	
Fan Cycled for Cooling?	N	
Supply Air Reset:	Not Used	
HEATING SYSTEM DATA		
Is Central Heating Used?	Y	
Fan Cycled for Heating?	N	
Supply Air Reset:	Not Used	
OUTDOOR VENTILATION DATA		
Type of Control:	Constant Ai	rflow Rate
Design Ventilation Airflow:	5000.0	CFM
Dampers Open During Unocc Per.:	N	
Damper Leak Rate:	2	9
SUPPLY DUCT DATA		
Duct Heat Gain:	2	8
Duct Leakage Rate:	5	8
RETURN PLENUM DATA		
Is a Return Plenum Used?	N	
SUPPLY FAN DATA		•
Fan Type:	Forward Cur	rvea
Configuration:	Draw-Thru	
Fan Total Static:		in.wg.
Fan Efficiency RETURN FAN DATA	54	6
Fan Type:	None	
OUTDOOR AIR ECONOMIZER	HOILE	
Outdoor Economizer Type:	Integrated	Dry-Bulb
OA Upper Cutoff Temp:	95.0	
OA Lower Cutoff Temp:	0.0	
PREHEAT COIL		
Preheat Coil Used?	N	
PRECOOL COIL		
Precool Coil Used?	N	
HUMIDIFICATION		
Humidification System Used?	N	
DEHUMIDIFICATION		
Dehumidification System Used?	N	
VENTILATION HEAT RECLAIM		
Reclaim Unit Type:	None	
SAFETY FACTORS		•
Sensible Cooling Factor:	-	8
Latent Cooling Factor:		96 9.
Heating Factor	_	8
	=============	

Name: Auditorium - DDC	12-30-94
Type: CONSTANT VOLUME - Single Zone CAV	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT	Page 2
*************	******
3. ZONE DATA	
	s the Same)
T-Stat Occupied Cooling(F): 75.0	
Unoccupied Cooling(F): 85.0	
Occupied Heating(F): 70.0	
Unoccupied Heating(F): 55.0	
Throttling Range(F): 3.0	
Zone Heating Unit Type None	
Trip Temperature(F):	
Design Supply Temperature(F):	
Fan Total Static(in.wg.):	
Fan Efficiency(%):	
Zone Terminal Type Diffuser	
Reheat Coil N	
Direct Exhaust Airflow(CFM): 0.0	
Direct Exhaust Fan kW(kW): 0.0	
4. SCHEDULE DATA	
HOURLY TSTAT SCHEDULES 0 0 0 0 0 0 0 0 1 1 1 1 1	
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4	5 6 / 6 9 0 1 2 3
Design Day	
Weekday	
Saturday	
Sunday	
	=======================================
Cooling Available During Unoccupied Period ? Y	
MONTHLY SCHEDULES JAN FEB MAR APR MAY JUN JUL AU	
Central Heating XXX XXX XXX XXX	
Central Cooling XXX XXX XXX XX	XX XXX

Name: Fan Coll Units - Basell	ine		12-30-94
Type: TERMINAL UNITS - 2-Pig	pe Fan Coils		HAP v3.04
Prepared by: EINHORN YAFFEE I	PRESCOTT		Page 1
*****		******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
	_		-
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st Fl	lr 1		
			==========
SPACES IN ZONE 2 (Zone 2)			
	- 		
2. South Perimeter - 1st I	Fl 1		
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st Fi			
======================================			
SPACES IN ZONE 4 (Zone 4)			
SPACES IN ZONE 4 (ZONE 4)			
4. North Perimeter - 1st 1			
4. NOICH FEITHECEL 150			
SPACES IN ZONE 5 (Zone 5)			
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd F			
6. East Perimeter - 2nd r.			
SPACES IN ZONE 6 (Zone 6)			
SPACES IN ZONE 6 (ZONE 6)			
7. South Perimeter - 2nd 1			
7. South Perimeter - Zhu h			
		=======================================	
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd F			
8. West Perimeter - 2nd r.			
SPACES IN ZONE 8 (Zone 8)			
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd			
9. North Perimeter - 2nd .			

Name: Interior 219 - Baseling Type: CONSTANT VOLUME - Sing		AV	12-30-94 HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
1. SPACE SELECTION			
Space Name	Qty 	Space Name	Qty
Space Name ===================================	Qty =======	Space Name	Qty =======

Name: Auditorium - Baseline			12-30-94
Type: CONSTANT VOLUME - Sing	rle Zone CA	V	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******		******	*******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
Space Name ====================================	Qty	Space Name	Qty

Name: Fan Coil Units - PLC			12-30-94
Type: TERMINAL UNITS - 2-F	-	oils	HAP v3.04
Prepared by: EINHORN YAFFEE			Page 1
******	*****	*******	******
1. SPACE SELECTION			
		Space Name	Qty
			-
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st	Flr 1		
SPACES IN ZONE 2 (Zone 2)			
2. South Perimeter - 1st			
=======================================	========		=======================================
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st			
SPACES IN ZONE 4 (Zone 4)			
4. North Perimeter - 1st			
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd			
SPACES IN ZONE 6 (Zone 6)			
7. South Perimeter - 2nd			
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd			
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd			

Name: Interior 219 - PLC			12-30-94
Type: CONSTANT VOLUME - Singl	le Zone	CAV	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
******	******	*******	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
=======================================	======		
SPACES IN ZONE 1 (Zone 1)			
5. Interior - 1st Flr	1	10. Interior - 2nd Flr	1

Name: Auditorium - PLC			12-30-94
Type: CONSTANT VOLUME - Sing	gle Zone C	AV	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
*******	*****	*****	******
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
=======================================	========		==========
SPACES IN ZONE 1 (Zone 1)			
11. Auditorium	1		

Name: Fan Coll Units - DDC Type: TERMINAL UNITS - 2-1	Pipe Fan Coi	ls	12-30-94 HAP v3.04
Prepared by: EINHORN YAFFER	E PRESCOTT		Page 1
*******	******	*******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st	Flr 1		
SPACES IN ZONE 2 (Zone 2)			
2. South Perimeter - 1st	Fl 1		
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st	Flr 1		
SPACES IN ZONE 4 (Zone 4)			
4. North Perimeter - 1st	Fl 1		
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd	Flr 1		
SPACES IN ZONE 6 (Zone 6)			
7. South Perimeter - 2nd	d Fl 1		
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd	Flr 1		
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd			

Name: Interior 219 - DDC			12-30-94
Type: CONSTANT VOLUME - Sing.	le Zone	CAV	HAP v3.04
Prepared by: EINHORN YAFFEE			Page 1
******			*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)	======		
5. Interior - 1st Flr	1	10. Interior - 2nd Flr	1

Name: Auditorium - DDC			12-30-94
Type: CONSTANT VOLUME - Sin	gle Zone CA	V	HAP v3.04
Prepared by: EINHORN YAFFEE	PRESCOTT		Page 1
******	*****	*******	*****
1. SPACE SELECTION			
Space Name	Qty	Space Name	Qty
=======================================	========	=======================================	=======================================
SPACES IN ZONE 1 (Zone 1)			
11. Auditorium	1		

Plant: Cooling Plant (Of Prepared By: EINHORN YAR	FFEE PRESCOTT	*****	*****	12-30-94 Page 1 ******
PLANT NAME, CLASSIFICATI	ON & TYPE			
Plant name	: Cooling: Air-Coo del: Compute: A/C Rec	g oled Chiller er-Generated ciprocating		
AIR SYSTEM SELECTIONS				
Air System Name			Quantity	
1. Fan Coil Units - 2. Interior 219 - Ba	Baseline			
AIR-COOLED RECIPROCATING	G CHILLER DATA			
Estimated maximum cool Chiller capacity at de Chiller input power at Chiller configuration. Is chilled water reset Is hot gas bypass used load for minimum uncorankcase heater kW	esign: design: used? loading:	NA 100.0 Tons 1.500 kW/T	'on	
PUMP AND PIPING SYSTEM I				
Pump or I Piping System		Efficienci Mech El		Piping Gain/Loss
Chilled Water	11.2 70.00	70.0 80	5.04	0.0

Plant: Heating Prepared By: E	INHORN YAFF	EE PRE	SCOTT	*****	******	*****	12-30-94 Page 1
PLANT NAME, CL	ASSIFICATIO	N & TY	PE				
Plant name Classificati Type	on	<i>.</i> . : :	Heatin Hot Wa	ig iter Boi	ler		
AIR SYSTEM SEL	ECTIONS					~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	
Air Syste				re-Heat	Central	l Category Termina	
1. Fan Coil	Units - Bas	eline.		-	1		-
2. Interior	219 - Basel	ine		-			-
3. Auditoriu	m - Baselin				1	-	-
	at design. ciency at d gy type ir blower k	esign. W	: N	3500.0 60.0 Mat. Gas 0.000	MBH % kW		
BOILER PART-	LOAD PERFOR	MANCE	DATA	. 			
% Load Over	all Eff. (%) %	Load	Overall	Eff. (%)		
90	60.0		40	6	0.0		
80	60.0		30				
70 60	60.0 60.0		20 10		0.0		
50	60.0		0		0.0		
PUMP AND PIPIN	IG SYSTEM DA	TA					
			Pumr	Effic	iencies	Pump	Piping
Pump or			Head	i Mech	Elec	Power	Gain/Loss
Piping System			(ft wg)		(%)	(kW)	(왕)
Hot Water					80.0	4.94	0.0

Plant: Cooling (Auditor	ium) - Ba	ase				12-30-94 Page 1
Prepared By: EINHORN YA	******	*****	*****	******	*****	raye 1
PLANT NAME, CLASSIFICAT		PE				
Plant name	: : odel:	Cooling Air-Coo Compute A/C Rec	led Chil r-Genera iprocati	ler ited .ng		
AIR SYSTEM SELECTIONS						
Air System Name			Type	Qua	intity	
3. Auditorium - Bas						
AIR-COOLED RECIPROCATIN						
Estimated maximum coc Chiller capacity at d	oling load lesign	1: :	NA 40.0 7	[ons		
Chiller input power a	it design	:	1.250 }	cW/Ton	/	
Chiller configuration Is chilled water rese			lt. Comp N	pressors	/ Ckt.,	Unloaded
Is hot gas bypass use	edb	?	N			
<pre>% load for minimum ur Crankcase heater kW</pre>						
Crankcase heater kw						
PUMP AND PIPING SYSTEM						
		Pump	Efficie	encies	Pump	Piping
Piping System	Delta-T (F)	Head (ft wg)	Mech (%)	Elec (%)	Power (kW)	Gain/Loss (%)
Chilled Water						

Plant: Cooling Plant (Offices) - PLC Prepared By: EINHORN YAFFEE PRESCOTT ***********************************	*****	12-30-94 Page 1 ******	
PLANT NAME, CLASSIFICATION & TYPE			
Plant name: Cooling P. Classification: Cooling Type: Air-Coole Type of simulation model: Computer-Type of chiller A/C Recip.	d Chiller Generated	es) - PLC	
AIR SYSTEM SELECTIONS			
Air System Name	Туре	Quantity	
4. Fan Coil Units - PLC	,	1	
AIR-COOLED RECIPROCATING CHILLER DATA			
Chiller input power at design: 1 Chiller configuration	NA 00.0 Tons .500 kW/Ton . Compresso N N 20.0 %		Unloaded
PUMP AND PIPING SYSTEM DATA			
Pump E Pump or Delta-T Head Piping System (F) (ft wg)	Mech Elec		
Chilled Water 11.2 70.00	70.0 80.0	5.04	0.0

Plant: Heating Plant - PLC Prepared By: EINHORN YAFFEE PRESCOTT ***********************************						
	E, CLASSIFICA					******
Classif	ameication	Hea	ating			
	M SELECTIONS					
	System Name			ating Coil Central	Category	,
5. Inte	Coil Units - 1 rior 219 - PLC torium - PLC.	2	· · · · · -	1		-
HOT WATER	BOILER DATA					
Gross of Energy Overall Fuel or	ed maximum heautput at designingut at designingut at designingut and energy type.	gn gn design	.: 2100.0 .: 3500.0 .: 60.0 .: Nat. Gas	MBH MBH % kW		
BOILER	PART-LOAD PER	FORMANCE DAT.				
% Load	Overall Eff.	(%) % Lo	ad Overall			
90 80 70 60 50	60.0 60.0		30 6 20 6 10 6			
PUMP AND	PIPING SYSTEM	DATA				
Pump or Piping Sy	stem	Delta-T (F) (ft		Elec	Power	Piping Gain/Loss (%)
Hot Water		20.0 7	0.00 70.0	80.0	4.94	0.0

Plant: Cooling (Audito Prepared By: EINHORN X	AFFEE PRE	SCOTT	*****	******	*****	12-30-94 Page 1 *****
PLANT NAME, CLASSIFICA		PE				
Plant name	nodel:	Cooling Air-Coo Compute A/C Rec	led Chil r-Genera	ller ated	PLC	
AIR SYSTEM SELECTIONS						
Air System Name			Type	Qua	antity	
6. Auditorium - Pl	. 					
Estimated maximum concluder capacity at Chiller input power Chiller configuration is chilled water results hot gas bypass us load for minimum Crankcase heater kW	design at design on set used sed	: 1: Mu ? ?	NA 40.0 5 1.250 }	Tons kW/Ton pressors		
PUMP AND PIPING SYSTEM	ATA M					
Pump or Piping System	Delta-T	Pump Head	Mech	Elec	Power	Piping Gain/Loss (%)
Chilled Water	12.4	70.00	70.0	80.0	1.82	0.0

Plant: Cooling Plant (Cooling Plant) Prepared By: EINHORN Y	AFFEE PRE	SCOTT	*****	*****	*****	12-30-94 Page 1
PLANT NAME, CLASSIFICAT	rion & TY	PE				
Plant name Classification Type Type of simulation mo	odel:	Cooling Air-Coo Compute A/C Rec	led Chil r-Genera iprocati	ller ated ing		
AIR SYSTEM SELECTIONS						
Air System Name			Туре	Qu	antity	
7. Fan Coil Units 8. Interior 219 - 1	DDC		. (2P-H		1	
AIR-COOLED RECIPROCATION		R DATA				
Estimated maximum coor Chiller capacity at a Chiller input power a Chiller configuration Is chilled water results hot gas bypass use a load for minimum use Crankcase heater kW.	oling loadesign at design at design at used et used nloading.	:: Mu?:	NA 100.0 7 1.500 } lt. Comp Y N 20.0 9	kW/Ton pressors	s / Ckt.,	Unloaded
PUMP AND PIPING SYSTEM						
Pump or Piping System	Delta-T	Pump	Efficie Mech	encies Elec	Power	Piping Gain/Loss
Chilled Water	11.2	70.00	70.0	80.0	5.04	0.0

Plant: Heating Plant - DDC 12-30-94 Prepared By: EINHORN YAFFEE PRESCOTT Page 1 ************************************							
PLANT NAME, CLASSIFICA							
Plant name	Heat:	ing Water Boil					
AIR SYSTEM SELECTIONS							
Air System Name		Hea Pre-Heat	ating Coil Central	Category Terminal	Zone		
7. Fan Coil Units - 8. Interior 219 - DD 9. Auditorium - DDC.	DDC	 	1 1 1	- -	- - -		
HOT WATER BOILER DATA							
Estimated maximum he Gross output at desi Energy input at desi Overall efficiency a Fuel or energy type. Combustion air blowe	gn	2100.0 3500.0 60.0	MBH MBH %				
BOILER PART-LOAD PER	FORMANCE DATA		,				
% Load Overall Eff.	(%) % Load	Overall					
90 60.0 80 60.0 70 60.0 60 60.0 50 60.0	40 30 20 10	60 60	0.0 0.0 0.0				
PUMP AND PIPING SYSTEM	DATA						
Pump or Piping System	Pur Delta-T He (F) (ft w	ad Mech		Pump Power (kW)	Piping Gain/Loss (%)		
Hot Water	20.0 70.	00 70.0	80.0	4.94	0.0		

Plant: Cooling (Audito Prepared By: EINHORN Y	rium) - D	SCOTT		*****	*****	12-30-94 Page 1 ******
PLANT NAME, CLASSIFICA		PE				
Plant name Classification Type Type of simulation m Type of chiller	odel:	Cooling Air-Coo Compute A/C Rec	led Chil r-Genera iprocat:	ller ated ing		
AIR SYSTEM SELECTIONS						
Air System Name			Type	Qua	antity	
9. Auditorium - DD	c		. (SZ (CAV)	1	
AIR-COOLED RECIPROCATI	NG CHILLE	R DATA				
Estimated maximum conchiller capacity at Chiller input power Chiller configuration Is chilled water results hot gas bypass us load for minimum Crankcase heater kW.	design at design on set used sed unloading.	: : Mu ? ?	40.0 1 1.250 l 1t. Comp N N 20.0	kW/Ton pressors	/ Ckt.,	Unloaded
PUMP AND PIPING SYSTEM						
Piping System		Head	Mech	Elec	Power	Piping Gain/Loss (%)
Chilled Water	12.4	70.00	70.0	80.0	1.82	0.0

Date of last		ING INPUT DATA		
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	******	*****	Pag *********	
	Buildin			
		-		. -
PLANT SELECT:				
Plant Na			e Quantity	
	Plant (Offices) - B			
	Plant - Baseline			
3. Cooling	(Auditorium) - Base	A/C CHII	LLER) 1	
MISCELLANEOU	ELECTRIC POWER USE			
		ax. Power Use		
Reference Nam		(kW)	Schedule Name	
Empty		0.0	NA	
Empty		0.0	NA	
Empty		0.0	NA	
Empty		0.0	NA	
Reference Name	Fuel Fuel Conv Type Units kBTU		Schedule Name	
Empty		0.0000 0.0	NA	
Empty		0.0000 0.0	NA NA	
Empty			NA	
Fuel Types: 1	NG=Nat.Gas FO=Fuel	Oil PR=Propar	ne RH=Rmt Htg	
ELECTRIC RAT	2			
	e:		Equivalent \$/kWh	
Average bui	ding power factor.:	NA		
FUEL RATES				
				
Natural gas		Washington Ga	as Rate Schedule 2	
				-
	ce heating			
kemote sour	ce cooling	None		

Prepared by: EINHORN YAFFEE PRESCOTT	12-30-94
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***********	******
MISCELLANEOUS DATA	
Additional building floor area: Source electric generating efficiency:	-

Prepared by:			BUILDING INPU	- Driin		
	EINHORN	YAFFEE	PRESCOTT			12-30-94
HAP v3.04					******	Page 1
					******	*****
			ilding 219 - 			
PLANT SELECTI	LON					
Plant Na	ame			Type	Quantity	
) - PLC (A/			
			(HW			
			PLC (A/		LER) 1	
MISCELLANEOUS	3 ELECTRI	C POWE	R USE			
			Max. Powe			
Reference Nam	ne		Max. Towe		Schedule Name	
Empty				0.0	NA	
Empty				0.0	NA	
Empty				0.0	NA	
Empty				0.0	NA	
MISCELLANEOUS	s FUEL US	E				
Reference			Conversion	Max.		
		Units		TT	Schedula Nama	
	Туре	011100	kBTU/Units	use	Schedule Name	
Empty	NG	THM	100.0000	0.0	NA	
Empty	NG NG	THM THM	100.0000	0.0	NA NA	
Empty Empty	NG NG NG	THM THM THM	100.0000 100.0000 100.0000	0.0	NA NA NA	
Empty Empty Empty	NG NG NG	THM THM	100.0000	0.0	NA NA	
Empty Empty Empty Empty	NG NG NG	THM THM THM THM	100.0000 100.0000 100.0000 100.0000	0.0 0.0 0.0 0.0	NA NA NA NA	
Empty Empty Empty Empty	NG NG NG	THM THM THM THM	100.0000 100.0000 100.0000 100.0000	0.0 0.0 0.0 0.0	NA NA NA	
Empty Empty Empty Empty	NG NG NG	THM THM THM THM	100.0000 100.0000 100.0000 100.0000	0.0 0.0 0.0 0.0	NA NA NA NA	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG	THM THM THM THM	100.0000 100.0000 100.0000 100.0000	0.0 0.0 0.0 0.0	NA NA NA NA	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG NG=NG=NG=NG=NG=NG=NG=NG=NG=NG	THM THM THM THM SFO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR	0.0 0.0 0.0 0.0	NA NA NA NA NA	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG NG NG=Nat.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0	NA NA NA NA NA	
Empty Empty Empty Empty Fuel Types: N ELECTRIC RATH Electric rat Average buil	NG NG NG NG NG=NAt.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA Le RH=Rmt Htg Squivalent \$/kWh	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG NG=NAt.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA NA	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG NG=NAt.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA Le RH=Rmt Htg Squivalent \$/kWh	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG=Nat.Ga te	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg	
Empty Empty Empty Empty Fuel Types: N	NG NG NG NG=Nat.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg quivalent \$/kWh	
Empty Empty Empty Empty Fuel Types: Natural gas	NG NG NG NG NG=Nat.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg	
Empty Empty Empty Empty Fuel Types: Negative fuel RATES Natural gas Fuel oil	NG NG NG NG NG=Nat.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg quivalent \$/kWh	
Empty Empty Empty Empty Fuel Types: Negative Propane	NG NG NG NG NG=Nat.Ga	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=: Ft. Bel tor:: NA	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg quivalent \$/kWh	
Empty Empty Empty Empty Fuel Types: Natural gas Fuel oil	NG NG NG NG NG=Nat.Ga te lding pow	THM THM THM THM S FO=	100.0000 100.0000 100.0000 100.0000 Fuel Oil PR=: Ft. Bel tor.: NA	0.0 0.0 0.0 0.0 Propan	NA NA NA NA e RH=Rmt Htg quivalent \$/kWh	

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***********	*****
MISCELLANEOUS DATA	
Padiking 1 building floor open	0 006
3	0 sqft
Source electric generating efficiency: 100.00) 8

	BOILDING INPOL DATA	
Prepared by:	EINHORN YAFFEE PRESCOTT	12-30-94
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	******	********
	Building 219 - DDC	
PLANT SELECTION		
Plant Na	ne Type	Quantity
	Plant (Offices) - DDC (A/C CHILLER	
	Plant - DDC (HW BOILER)	1
	(Auditorium) - DDC (A/C CHILLER	_
	(Additolium) - DDC (A/C CHIDDER	
ATCORT I ANDOTIC	ELECTRIC POWER USE	
	Max. Power Use	
Reference Nam		chedule Name
Empty	0.0 NA	Į.
Empty	0.0 NA	A.
Empty	0.0 NA	\mathcal{L}
Impty	0.0 NA	Ą
MISCELLANEOUS	FUEL USE	
Reference	Fuel Fuel Conversion Max.	
Name	Type Units kBTU/Units Use So	chedule Name
Empty	NG THM 100.0000 0.0 NA	Ą
Empty	NG THM 100.0000 0.0 NF	\mathcal{F}
Empty	NG THM 100.0000 0.0 NA	J
Empty	NG THM 100.0000 0.0 NA	A
Fuel Types: N	G=Nat.Gas FO=Fuel Oil PR=Propane	
ELECTRIC RATE		
	e Ft. Belvoir Equ	ivalent \$/kWn
Average buil	ding power factor.: NA	
FUEL RATES		
	Washington Gas I	Rate Schedule 2
	None	
	None	
	e heating None	
kemote sourc	e cooling: None	

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******************	******
MISCELLANEOUS DATA	
Additional building floor area 0.0 s	qft
Source electric generating efficiency 100.00 %	